



# **ARMY NET ZERO PROVE OUT**

## **Final Net Zero Training Report**

**November 20, 2014**

Distribution A

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Office of the Deputy Assistant Secretary of the  
Army for Energy and Sustainability (ODASA[E&S])  
110 Army Pentagon, Room 3D453 Washington DC  
20310-0110

Contract No. W91ZLK-10-D-0005

Task No. 0818

CDRL No. A0007

*Submitted by*



*Concurrent Technologies Corporation*

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<b>REPORT DOCUMENTATION PAGE</b>			Form Approved OMB No. 0704-0188	
Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden to Washington Headquarters Services, Directorate for information operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, D.C. 20503.				
1. AGENCY USE ONLY (Leave blank)		2. REPORT DATE November 20, 2014		3. REPORT TYPE AND DATES COVERED Final (5/23/13 – 11/22/14)
4. TITLE AND SUBTITLE Army Net Zero Training			5. FUNDING NUMBERS Contract: W91ZLK-10-D-0005 Task: N.0818	
6. AUTHOR(S) Caroline Harrover, Karen Downs, Arielle Wait, Elizabeth Keysar and Heidi Kaltenhauser				
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) National Defense Center for Energy and Environment Operated by Concurrent Technologies Corporation 100 CTC Drive Johnstown, PA 15904			8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) NDCEE Program Office (Office of the Assistant Secretary of the Army for Installations and Environment) 5850 21 <sup>st</sup> Street, Building 211 Fort Belvoir, VA 22060-5527 Program Manager: Mr. Erik Hanageland, NDCEE Program Manager, 410-306-3184			10. SPONSORING/MONITORING AGENCY REPORT NUMBER NDCEE-CR-2014-091	
11. SUPPLEMENTARY NOTES				
12a. DISTRIBUTION/AVAILABILITY STATEMENT Distribution A Approved for public release, distribution is unlimited			12b. DISTRIBUTION CODE	
13. ABSTRACT (Maximum 200 words)  In support of Task No. 0818, "Army Net Zero Prove-Out," the National Defense Center for Energy and Environment (NDCEE), operated by Concurrent Technologies Corporation (CTC), was tasked to provide the Office of the Deputy Assistant Secretary of the Army for Energy & Sustainability (ODASA[E&S]) support to the office in a number of areas, including drafting Net Zero training briefs and scripts to record online via the Defense Connect Online (DCO) website. Six training modules were developed with an Army installation energy, water, and waste Program Manager (or equivalent) and/or Sustainability Officer as the target audience. Each module was developed to be approximately 60 minutes in length containing approximately 30 presentation slides with accompanying scripts. The following list the modules which were archived via the Net Zero SharePoint site after recording: Module 1 Net Zero 101 (Appendix A); Module 2 Net Zero Approach (Appendix B); Module 3 Net Zero Energy (Appendix C); Module 4 Net Zero Water (Appendix D); Module 5 Net Zero Waste (Appendix E); and Module 6 Net Zero Resources (Appendix F).				
14. SUBJECT TERMS			15. NUMBER OF PAGES 352	
			16. PRICE CODE	
17. SECURITY CLASSIFICATION OF REPORT Unclassified	18. SECURITY CLASSIFICATION OF THIS PAGE Unclassified	19. SECURITY CLASSIFICATION OF ABSTRACT Unclassified	20. LIMITATION OF ABSTRACT None	

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## **LIST OF ACRONYMS AND ABBREVIATIONS**

ACOM	Army Command
ASA(IE&E)	Assistant Secretary of the Army for Installations, Energy and Environment
BMP	Best Management Practice
CTC	Concurrent Technologies Corporation
DCO	Defense Connect Online
DRU	Direct Reporting Unit
EPA	Environmental Protection Agency
FEMP	Federal Energy Management Program
NDCEE	National Defense Center for Energy and Environment
NZA	Net Zero Actions
OASA(IE&E)	Office of the Assistant Secretary of the Army for Installations, Energy and Environment
ODASA(E&S)	Office of the Deputy Assistant Secretary of the Army for Energy & Sustainability



## EXECUTIVE SUMMARY

In support of Task No. 0818, “Army Net Zero Prove-Out,” the National Defense Center for Energy and Environment (NDCEE), operated by Concurrent Technologies Corporation (CTC), was tasked to provide the Office of the Deputy Assistant Secretary of the Army for Energy & Sustainability (ODASA[E&S]) support to the office in the transition and institutionalization of Net Zero concepts, responsibility, methods, and implementation activities from the pilot installations and currently directed by the Army Secretariat Office of the Assistant Secretary of the Army for Installations, Energy and Environment (OASA[IE&E]) to the appropriate Army Commands (ACOMs)/Direct Reporting Units (DRUs) and all Army installations. In support of this effort, the NDCEE drafted Net Zero training briefs and scripts to record online via the Defense Connect Online (DCO) website. Six (~60 minute) training modules were developed with each containing approximately 30 presentation slides and accompanying scripts. The modules were archived via the Net Zero SharePoint site after recording. The training modules, listed below, were developed as an online resource due to current government limitations on travel and in-person conferences:

- Module 1 Net Zero 101 (Appendix A);
- Module 2 Net Zero Approach (Appendix B);
- Module 3 Net Zero Energy (Appendix C);
- Module 4 Net Zero Water (Appendix D);
- Module 5 Net Zero Waste (Appendix E); and
- Module 6 Net Zero Resources (Appendix F).

The overall purpose of the training is to present relevant information to support an installation’s journey towards Net Zero, emphasizing the specific hierarchy of approaches the Army has developed for Net Zero Energy, Net Zero Water, and Net Zero Waste and sharing best practices and lesson’s learned from the participants of the Army’s Net Zero Pilot Installation Initiative. The target audience for this training is Directorate of Public Works staff such as Master Planners and Program Managers (especially for energy, water and solid waste) or other applicable garrison staff such as the Installation Sustainability Officer.

Ms. Kristine Kingery, Assistant Secretary of the Army for Installations, Energy and Environment (ASA-IE&E) Director, Sustainability Policy recorded the scripts developed by the NDCEE in concert with the presentation slides via DCO.

The following provides a list of topics covered and objectives of each of the training modules:

**Module 1 Net Zero 101:** This training module provides a summary of all the topics covered in all of the modules and contains an overview of the history of sustainability from the perspective of the Army and issues and successes of two of the installations that pioneered the sustainability movement within the Army – Fort Bragg and Fort Carson. This module covers legal drivers, the goals and strategies of the Net Zero Hierarchy, the Pilot Installation Initiative, and successes and best practices for all three areas of Net Zero. The main objective of this training is a basic understanding of the Net Zero Initiative– what it is – what it means to someone who works on an Army installation, what the requirements are and what are other installations doing? One of

the most important things to learn from this training is that there is a specific hierarchy of approaches the Army has developed for Net Zero Energy, Net Zero Water, and Net Zero Waste. In other words – the order in which Net Zero approaches should be implemented. This module explores the evolution of the Net Zero Installation Initiative from inception to implementation Army-wide.

**Module 2 Net Zero Approach:** The bulk of this session provides instructions on the step-by-step process installations have to take to implement Net Zero. These steps, defined below, have been specifically developed for Army installations as a result of working with pilot installations from the Army's Net Zero Pilot Installation Initiative:

The first is Step 0 - "Initiate." This step involves identifying and engaging key stakeholders, gathering baseline data and establishing a baseline so that progress can be measured. The second is Step 1 - "Assess" where a more in-depth data gathering and analysis is conducted on the installations' current resource use, needs of the installations and opportunities that should be considered. These opportunities are listed in order of priority and further evaluated and validated in the third step which is Step 2 - "Plan". And in the final step Step 3 "Implement" the focus is on the various approaches to implementing Net Zero at an Army installation. Throughout this module the term 'Net Zero Actions' or "NZA's" (used in recent Army Net Zero written reports and other literature) refers to potential opportunities or projects installations evaluate and if proven feasible - are carried through to implementation.

The objective of this training is to present an implementation framework to assist Army installation personnel in their journey towards Net Zero. The Army recognizes that in an era of declining resources and tight fiscal constraints, installations must think innovatively about meeting existing requirements. This training, largely based on the Army's Net Zero Installation Implementation Guide, seeks to facilitate this innovation. By the end of this training module, the participant should know that there is a process for implementing Net Zero at an installation, be familiar with what takes place within each of the four (4) steps of that process and begin to think about what Net Zero action - a project, a new process or modified program -will work best at the participant's installation.

**Module 3 Net Zero Energy:** This module reviews the Federal, DoD and Army regulations that have shaped Net Zero Energy – the goals and the reporting requirements mandated from those regulations and how the Army now defines Net Zero Energy. The Army's Net Zero Pilot Installation Initiative and the Net Zero Hierarchy as related to energy is summarized along with how Net Zero Energy baselines were determined, and results of all of the assessments and audits conducted on the pilot installations. An introduction to the contracting and funding mechanisms available to the Army is provided – along with project assessment criteria developed by the Office of Energy Initiatives. A couple stellar examples are showcased along with a discussion about what's worked for some installations (best practices) and how to overcome those challenges that Army installations may still be facing (lessons learned).

The main objective of this training is to provide a basic understanding of Net Zero Energy– what it is – what it means to someone who works on an Army installation and how to implement Net

Zero at their installation. Specifically this module will detail what other Army installations are doing and lessons learned from their efforts.

Through three plus years of providing support to, working with, and gleaning knowledge from the eight (8) Army NZ Energy pilot installations and one (1) statewide Army National Guard location, the Army has a better understanding of what installations need to do to journey towards NZ Energy. Energy Efficiency Assessments, Renewable Energy Assessments, the NZ Energy Security Action Plan, the Integrated Energy and Water Security Assessment, the Energy ‘Roadmaps’ or what we now call ‘Plans’ and a NZ Solution Summary for the Pilots are covered. While this training cannot possibly instruct on how to conduct all of these – it will give an installation energy program manager an idea of what’s involved in these assessments, help determine if their installation needs one and how to pursue the required resources to accomplish these assessments.

**Module 4 Net Zero Water:** This module reviews the driving forces behind Net Zero Water – including the regulatory drivers and ones that push Net Zero Water to the forefront because of their potential threat to continued mission at an Army installation – such as drought and water scarcity. The complexities of climate change are outside the focus of this training module, but are summarized briefly. The bulk of this training focuses on 1) water balances that quantify water use and identify areas for water reduction and efficiency improvements and 2) plans where water conservation measures were identified and a life-cycle cost analysis was performed for each. The Federal Energy Management Program (FEMP) and Environmental Protection Agency (EPA) WaterSense Program related to best management practices (BMPs) is explored and one is presented in detail. And finally, information and guidance is provided on processes, programs and procedures related to Net Zero Water that have been determined to be a best practice at Army installations, stellar examples and lessons learned’. The objective of this training is to present relevant information on how the Army’s Net Zero Water definition supports efforts to meet and/or exceed mandates, regulations, and goals, how water issues impact Army installations and how managing water resources sustainably is a mission enabler in that it ensures the Army will have the water it needs to train and operate today and in the future.

**Module 5 Net Zero Waste:** This module covers the driving forces behind Net Zero Waste, revisits the inverted triangle that represents the Army’s priority of approaches to Net Zero Waste, and ‘re-reviews’ the Army’s Net Zero Pilot Installation Initiative specific to the Net Zero Waste, and provides an overview of what the Net Zero Waste pilots have accomplished. The objective of this training is to present relevant information to support installations in their journey towards Net Zero Waste. This module delves into the concepts, data, and resources required and best practices available to develop an approach to implementing Net Zero Waste including material flow analysis and identifying and implementing waste reduction, re-use, and diversion opportunities.

**Module 6 Net Zero Tools and Resources:** This module presents the most current tools and resources readily available (online) to help an installation in their journey towards Net Zero

and provides an overview of the previous Net Zero training modules. This module specifically focuses on tools to support Step 2 – Plan of the Net Zero Approach.

## **APPENDIX A**

### **Net Zero Training Module 1 Net Zero 101**



Appendix A Module  
Speaker Notes



Net Zero Training  
Module

## **Appendix A**

***Task 0818, "Army Net Zero Prove Out  
Final Net Zero Training Report***



# Army *Net Zero*

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## Army Net Zero Training Module 1: Net Zero 101

Assistant Secretary of the Army  
(Installations, Energy & Environment)





# Module 1 – Net Zero 101

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- Target Audience and Learning Objectives
- History of Sustainability in the Army
- Original Definitions
- History of the Pilot Installations / Pilot Implementation Activities
- Net Zero Definitions
- Evolution of the Hierarchy
- Army Directive
- Net Zero Army Wide
- Lessons Learned/Challenges/Best Practices
- Collaboration
- Emerging Sustainability Issues
- Next Steps





# Modules 2 – 6

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- Module 2: Army Management Approach to Net Zero
- Module 3: Net Zero Energy
- Module 4: Net Zero Water
- Module 5: Net Zero Waste
- Module 6: Net Zero Resources/Tools







# Learning Objectives



1. Learn about the Army's Net Zero Initiative; the drivers, the history of Sustainability in the Army and the evolution of the definitions of Net Zero Energy, Net Zero Water and Net Zero Waste
2. Discover how the seventeen Army sites were chosen for the Army Net Zero Pilot Installation Initiative and review examples of their activities and contributions to the Army's future success in Net Zero efforts in the way of lessons learned and best practices
3. Provide instructions on the hierarchy of implementation approaches and path forward

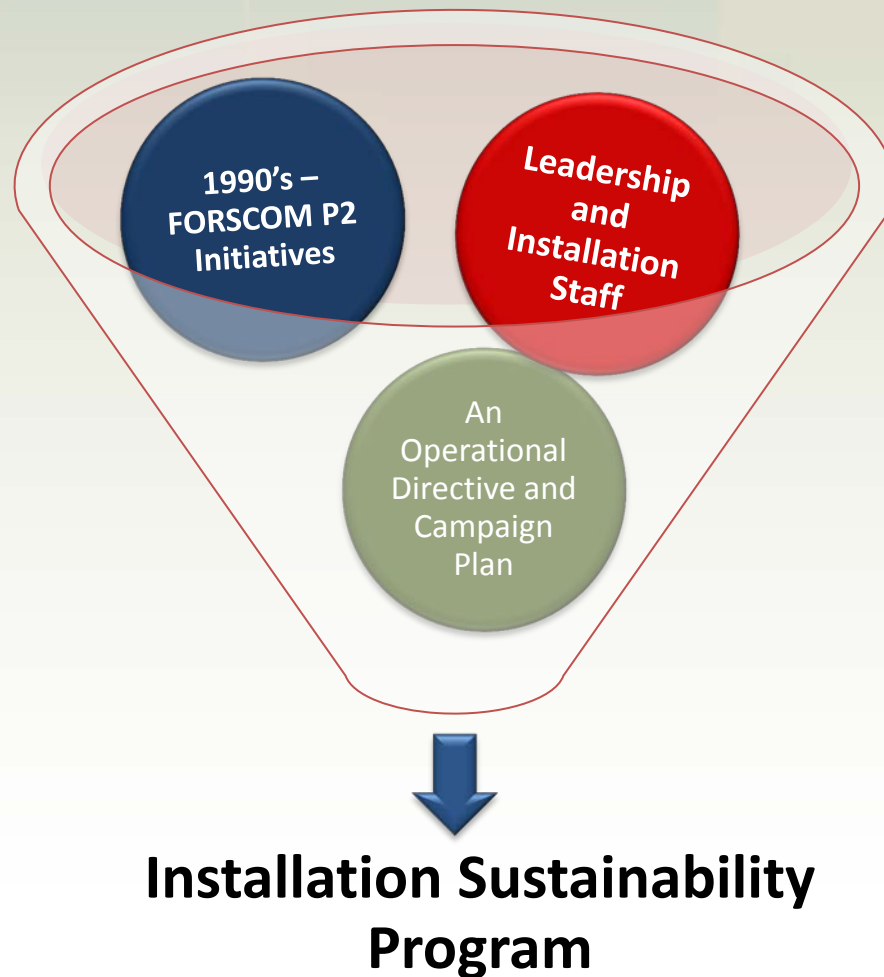




# The History of Army Sustainability



## Why & Where it Started





# Fort Bragg



## Issues that threatened its mission:

- Threatened & endangered species
- A training land shortfall & a community growing up to the fenceline
- Regional air quality that didn't meet federal standards & potential constraints on smoke/obscurant use, construction, & transportation
- Annual water demand of over 3 billion gallons & upstream demand for water growing exponentially
- Skyrocketing resource costs (\$40M/yr for energy alone)



**Incompatible development near Fort Bragg's Ste. Mere Eglise drop zone, which can no longer be used for some activities**



# Fort Carson



Fort Carson has realized many successes since hosting their 1<sup>st</sup> Sustainability Conference in 2002



Source: Ms. Sally Atkins Fort Carson Air PM JSEM 20 March 2006



# 2004: 1<sup>st</sup> Army-Level Strategy



## A sustainable Army simultaneously:

- meets current & future mission requirements worldwide
- safeguards human health
- improves quality of life, &
- enhances the natural environment

Source: *Army Strategy for the Environment*

### Strategy's Goals

- Foster a sustainability ethic
- Strengthen Army operations
- Meet test, training, & mission requirements
- Minimize impacts & total ownership costs
- Enhance well-being
- Drive innovation



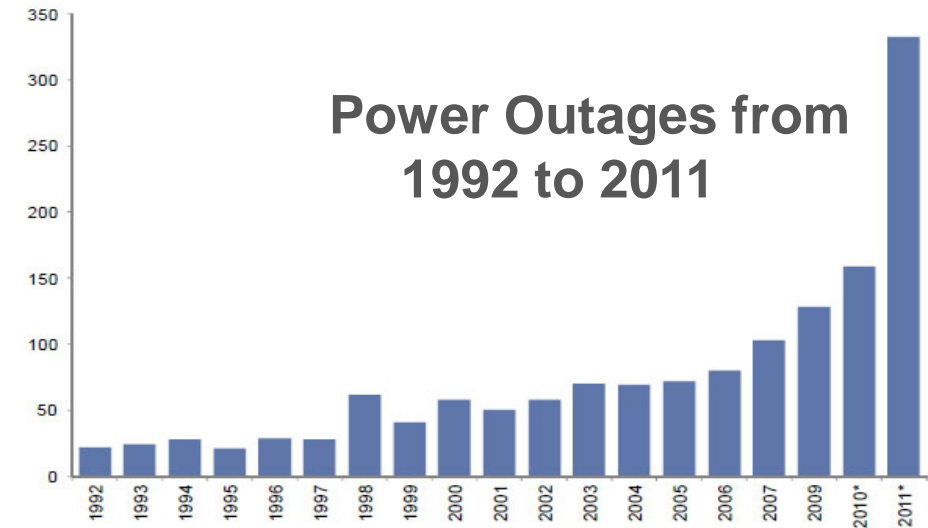
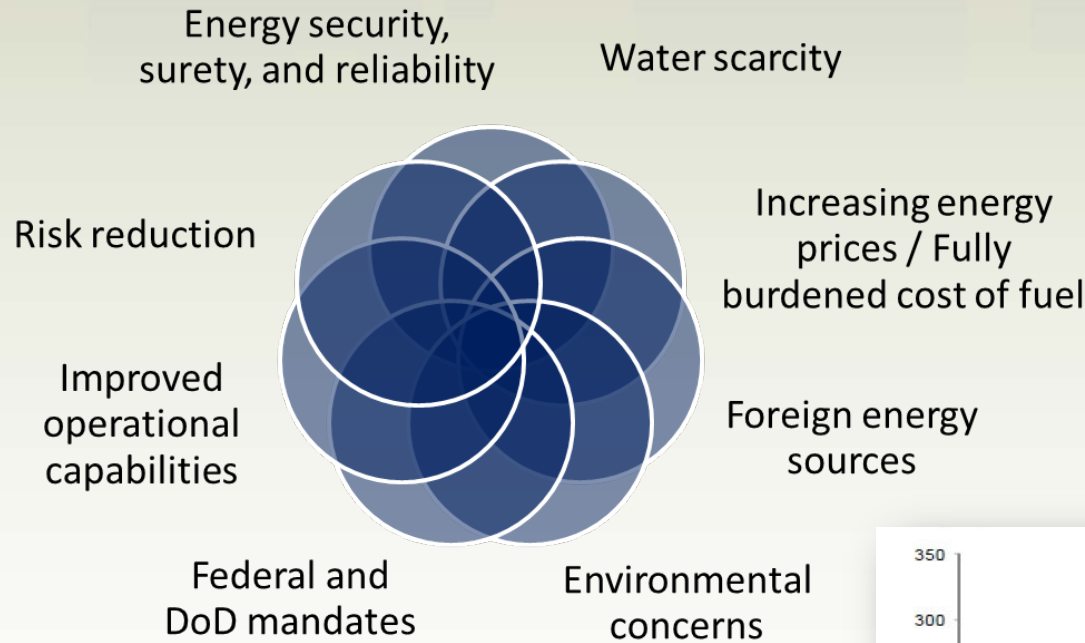
### “Triple Bottom Line – Plus”

- Mission, Environment, Community + Economy





# Drivers of Change



Note: \* NERC equivalent data estimated based on the trends seen in the Eaton Blackout tracker for number of outages affecting over 50,000 people.  
Source: NERC, Eaton Blackout Tracker, Goldman Sachs Research estimates.



# Origins of Net Zero



Federal Mandate	Focus Area	Performance Target
Energy Policy Act of 2005	Electricity use for federal government from renewable sources	• At least 3% of total electricity consumption (FY07-09), 5% (FY10-12), 7.5% (FY13 +)
Executive Order 13423	Energy use in Federal buildings	• Reduce 3% per year to total by 30% by FY2015 (FY2003 baseline)
	Total consumption from renewable sources	• At least 50% of required annual renewable energy consumed from "new" renewable sources
	Fleet vehicle alternative fuel use	• Increase by 10% annually to reach 100% (FY2005 baseline)
Energy Independence & Security Act of 2007	Total consumption from renewable sources	• 25% by FY2012 (FY2005 baseline)
	Hot water	• Effective
	Fossil fuel	• 20030
Executive Order 13514	GHG emissions	• GHGs by 34% by FY2020
	Net zero buildings	• All new buildings that enter design in FY2020 & after achieve net zero energy by FY2030
	Water consumption	• Reduce consumption by 2% annually for 26% total by FY2020 (FY2007 baseline)
	Waste minimization	• Divert at least 50% of solid waste & 50% of C&D waste by FY2015
National Defense Authorization Act, 2010	Renewable fuels use	• Directs the Secretary of Defense to consider renewable fuels in aviation, maritime, and ground transportation fleets.
	Facility renewable energy use	• Produce or procure 25 % of the total quantity of facility energy needs, including thermal energy, from renewable sources starting in FY2025

Performance  
Targets

## DoD-DOE Initiative NZEI Task Force

### Background

- DoD, Army, Air Force, Navy, Marines and DOE joint task force (Initiative formally implemented in 2008)
- Pilot NZEI demonstration sites at each of the Services

### Goals

- Create a repeatable template for planning and developing net zero energy installations across the Services (**draft template complete 5/2010**)
- Affect major increases in deployed energy efficiency and renewable energy

### Approach

- Task Force coordination and oversight, select pilot installations
- Comprehensive systems perspective
- Support begins with planning, continues through project implementation

# Original Net Zero Definitions



- **A Net Zero ENERGY Installation** is an installation that produces as much energy on site as it uses, over the course of a year.
- **A Net Zero WATER Installation** limits the consumption of freshwater resources and returns water back to the same watershed so not to deplete the groundwater and surface water resources of that region in quantity or quality.
- **A Net Zero WASTE Installation** is an installation that reduces, reuses, and recovers waste streams, converting them to resource values with zero solid waste to landfill.
- **A Net ZERO INSTALLATION** applies an integrated approach to management of energy, water, and waste to capture and commercialize the resource value and/or enhance the ecological productivity of land, water, and air.

“The primary goal is a focus toward net zero and when we talk about net zero, it's not only net zero energy, but it's net zero energy, water, and waste. When you look at the term "net zero" or a hierarchy of net zero you must start with reduction, then progress through repurposing, recycling, energy recovery, disposal being the last.”

— HON Katherine Hammack, DoD Bloggers Roundtable, 10 October 2010







# Pilot Installations

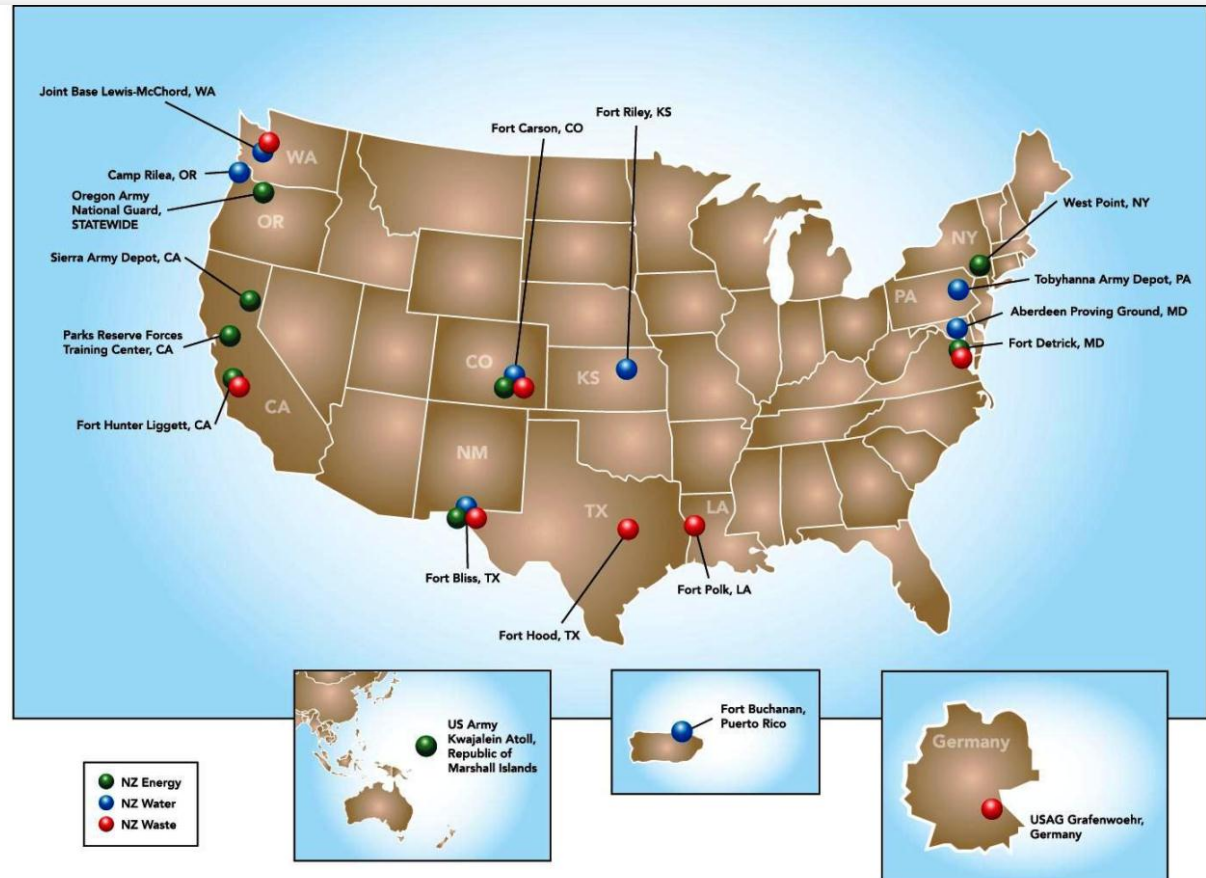


## Net Zero Pilot Installations:

Aberdeen Proving Ground  
Camp Rilea  
Fort Bliss  
Fort Buchanan  
Fort Carson  
Fort Detrick  
Fort Hood  
Fort Hunter Liggett  
Fort Polk  
Fort Riley  
Grafenwoehr  
Joint Base Lewis-McChord  
Kwajalein Atoll  
Parks Reserve Forces Training Center  
Sierra Army Depot  
Tobyhanna Army Depot  
West Point

## State-Wide Pilot:

Oregon Army National Guard

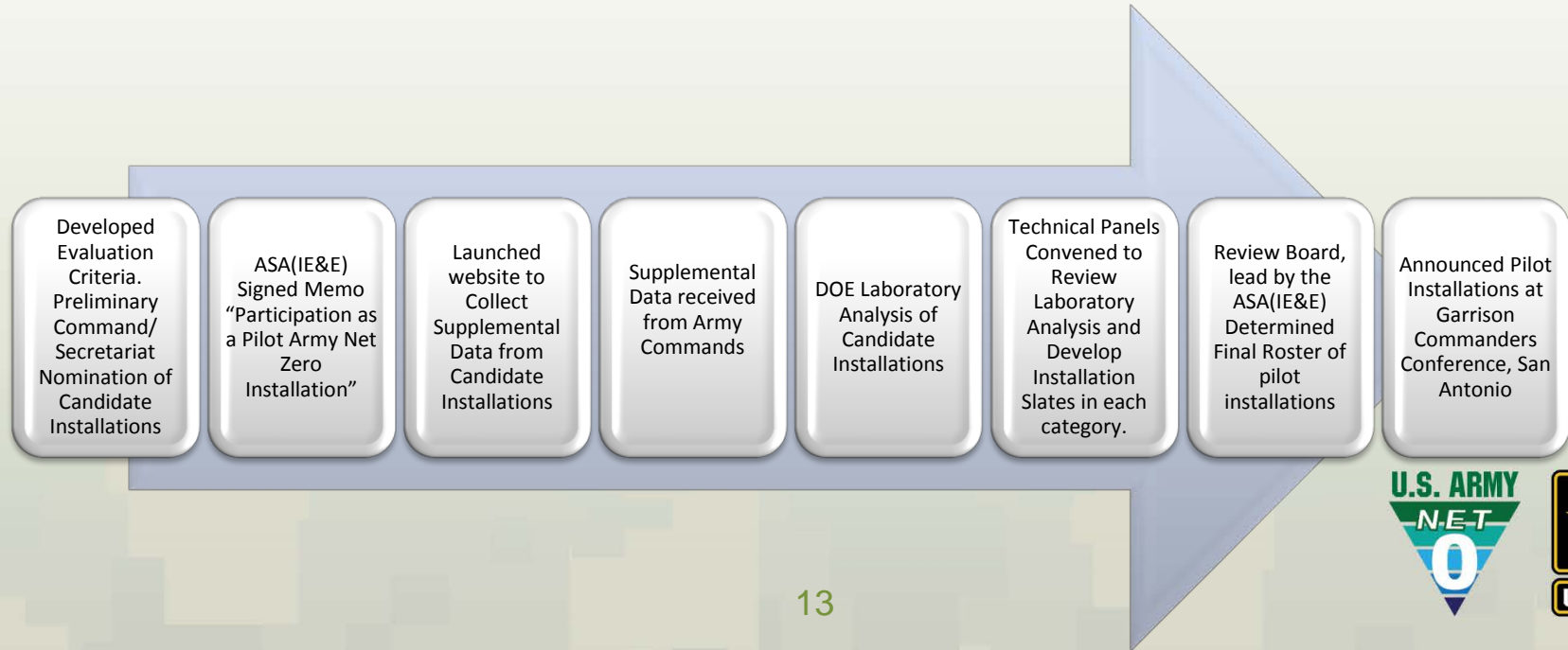




# Pilot Selection Process Criteria



- Viable strategy that addressed Net Zero hierarchy (reduction, re-purpose, recycling & composting, energy recovery, and disposal)
- Complied with Net Zero definitions
- Demonstrated success
- Multi-faceted approach to funding
- Diversity in size, mission, and geographic location



# Pilot Implementation Activities



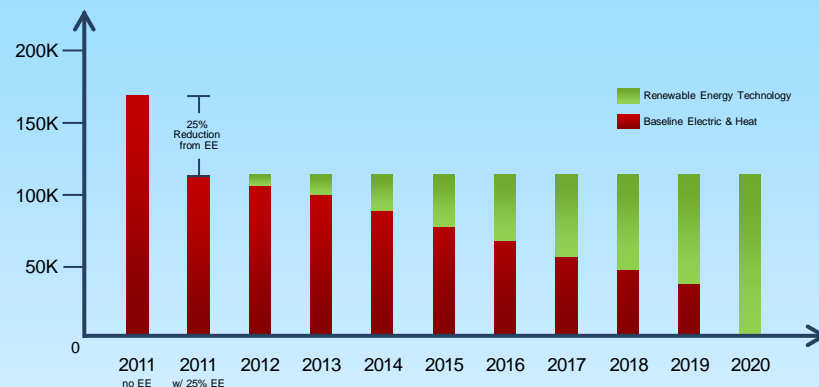
**Initiate:** Establish a baseline

**Assess:** Determine potential

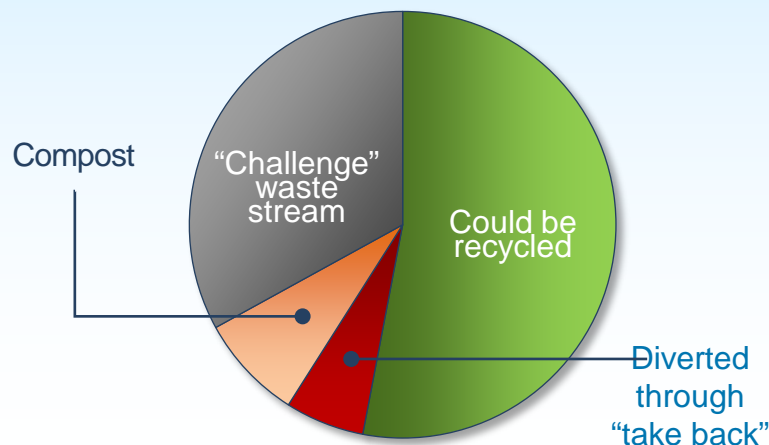
**Roadmap:** Plan and integrate the results into existing programs

**Implement:** Collaborate and act

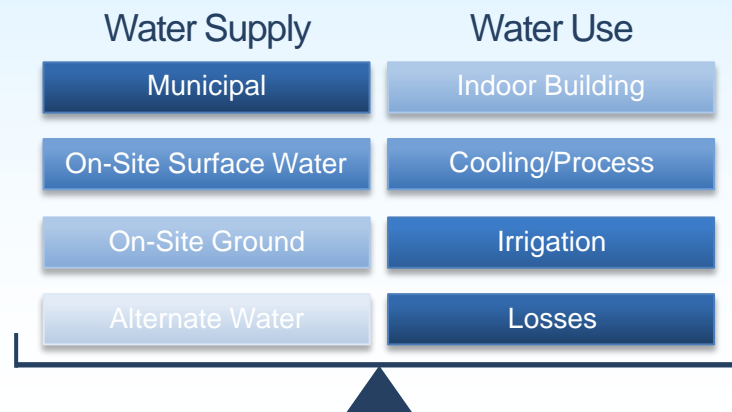
## Load Reduction and Renewable Energy Integration Roadmap



## Material Flow Analysis



## Water Balance Framework



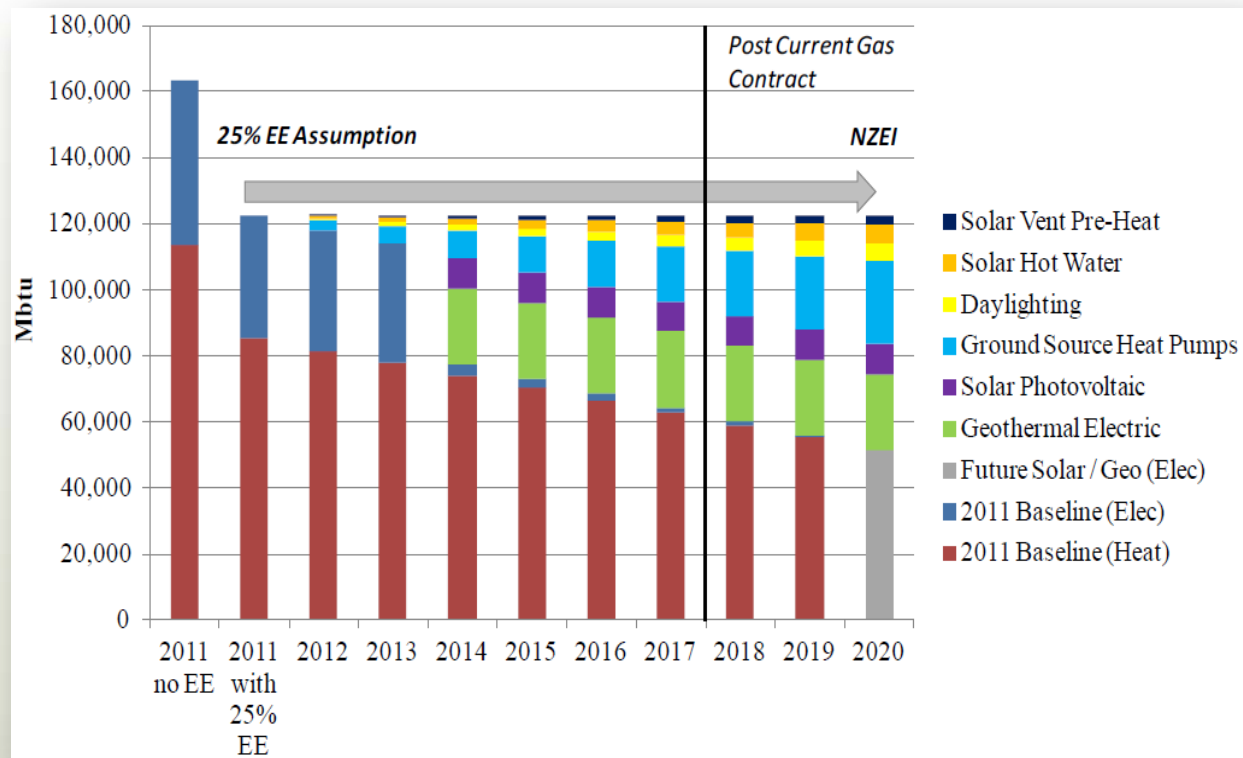


# Net Zero Energy Roadmaps



- Energy Baseline
- Energy Efficiency Assessments
- Renewable Energy Assessments
- Energy Security Assessments
- Energy Project List & Implementation Recommendations

## Sierra Army Depot Load Reduction and Renewable Energy Integration Roadmap





# Net Zero Water Roadmaps



## ■ Water Balance

- Identify largest end-users
- Set priorities

## ■ Water Efficiency

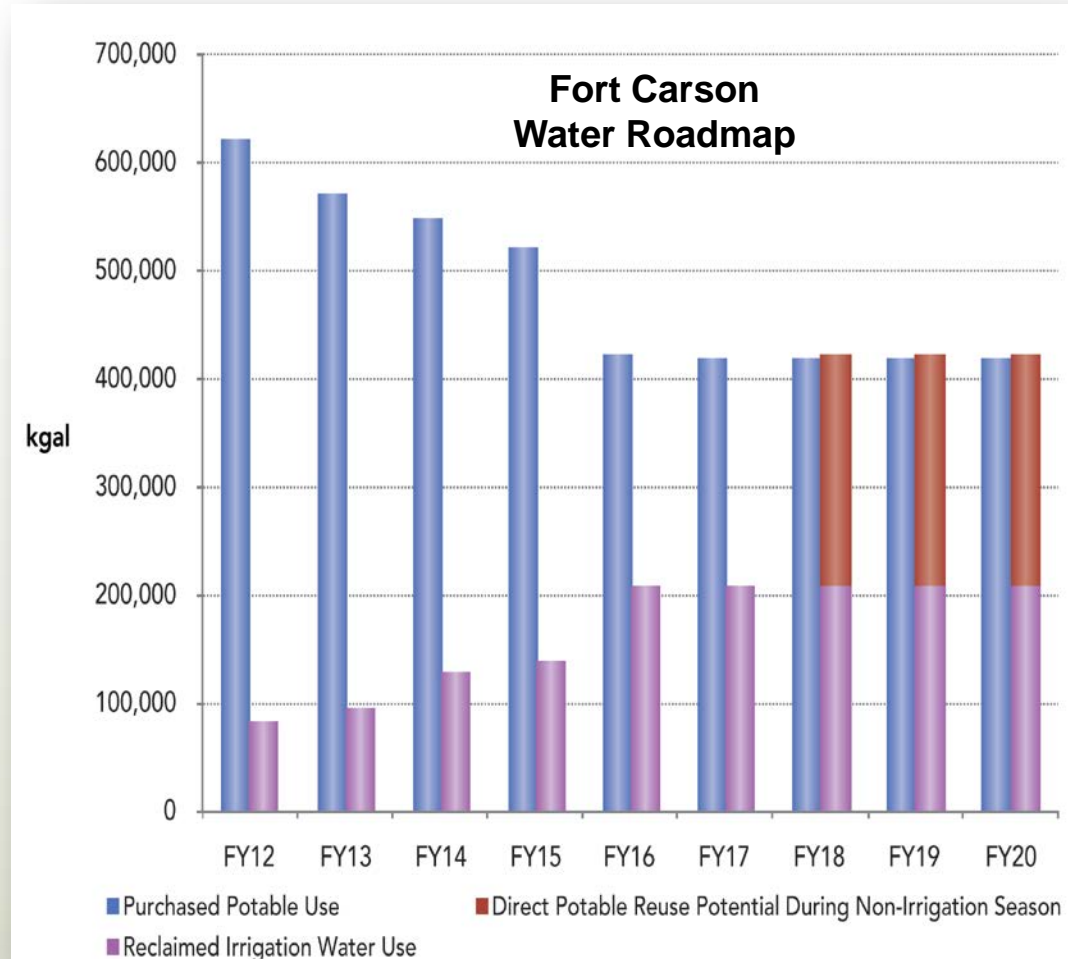
- Perform LCC analysis on measures
- Rank order projects
- Include technology and behavioral changes needed

## ■ Roadmap Workshop

- Collaborate with site
- Set priorities
- Identify funding
- Determine acquisition strategy

## ■ Roadmap and Master Planning

- Finalize strategy
- Incorporate into master planning



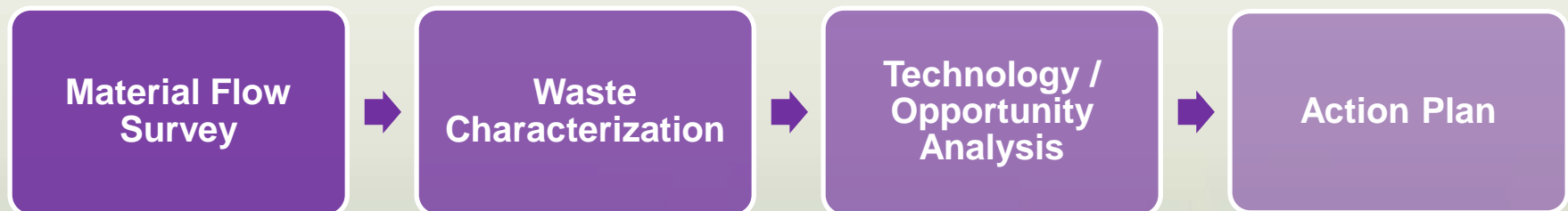
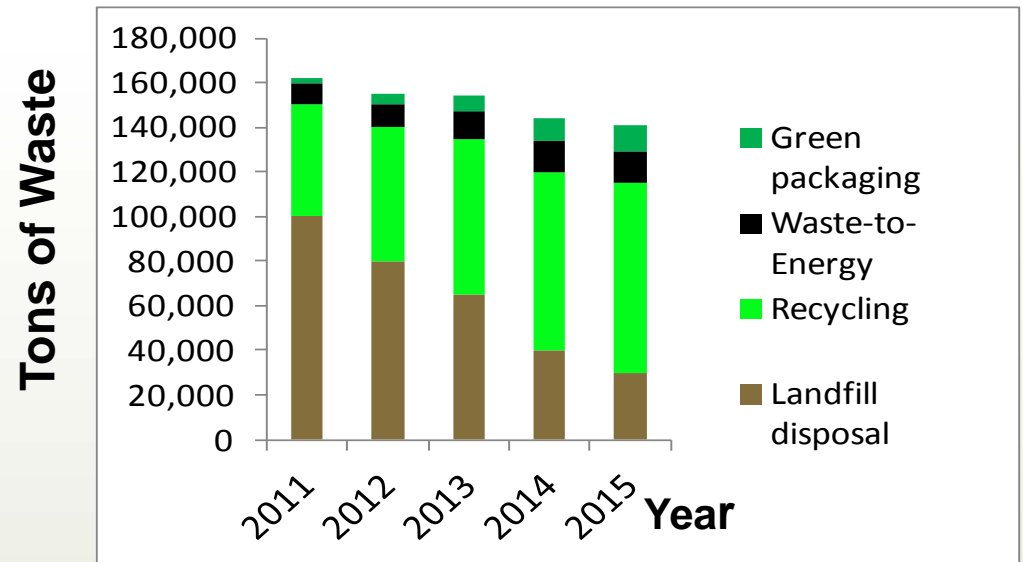


# Net Zero Waste Roadmaps



- Material flow analysis
- Improved procurement practices
- Re-purpose / Re-use strategy
- Recycling & composting strategy
- Potentially viable technologies

## Example Installation Waste Profile



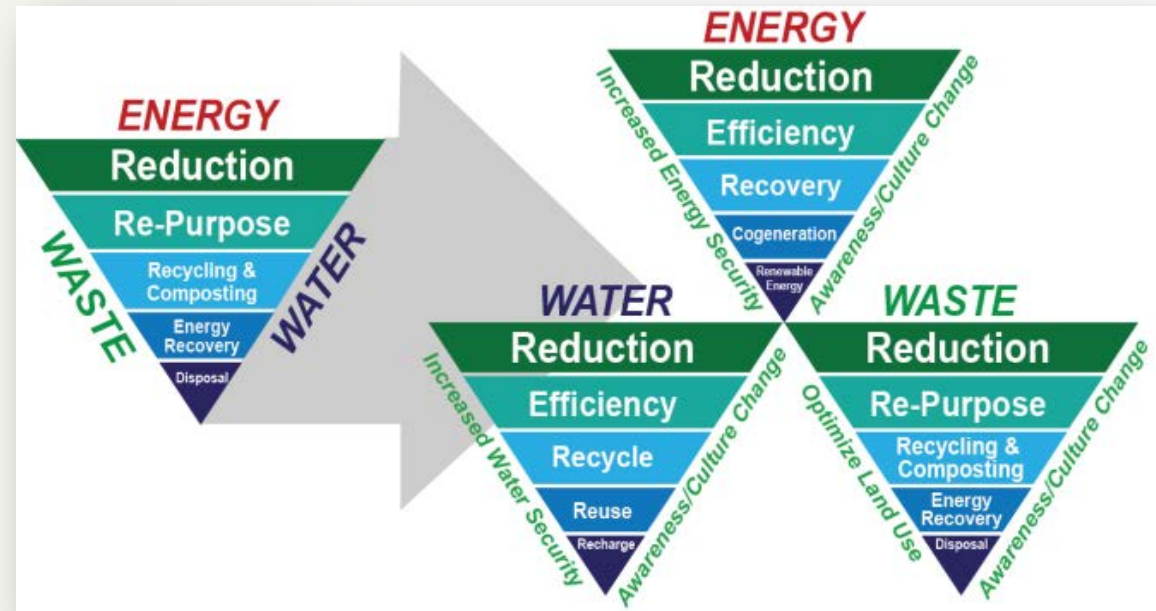




# Evolution of the NZ Hierarchy



Recognizing the need to capture the different strategies applicable to each area of NZ, the hierarchy was refined into subordinate hierarchies for each area of Net Zero.



Common to all are Reduction and Awareness/Culture Change.

The Net Zero Hierarchy captures differences in each area:

## Energy:

Efficiency  
Recovery  
Co-generation  
Renewable Energy  
Increased Energy  
Security

## Water:

Efficiency  
Recycle  
Reuse  
Recharge  
Increased Water  
Security

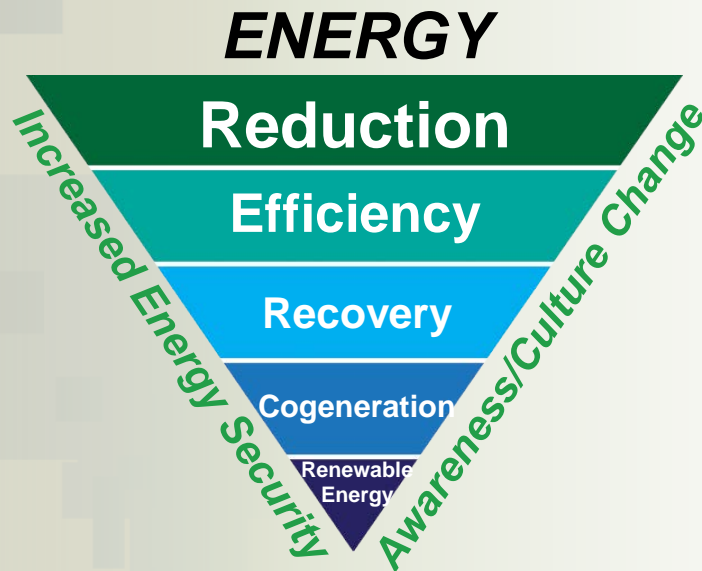
## Waste:

Re-purpose  
Recycling/Composting  
Energy Recovery  
Disposal  
Optimize Land Use





# Net Zero Energy



## Net Zero ENERGY:

Reduce overall energy use, maximize efficiency, implement energy recovery and cogeneration opportunities, and then offset the remaining demand with the production of renewable energy from on-site sources

## Holistic Approach Includes:

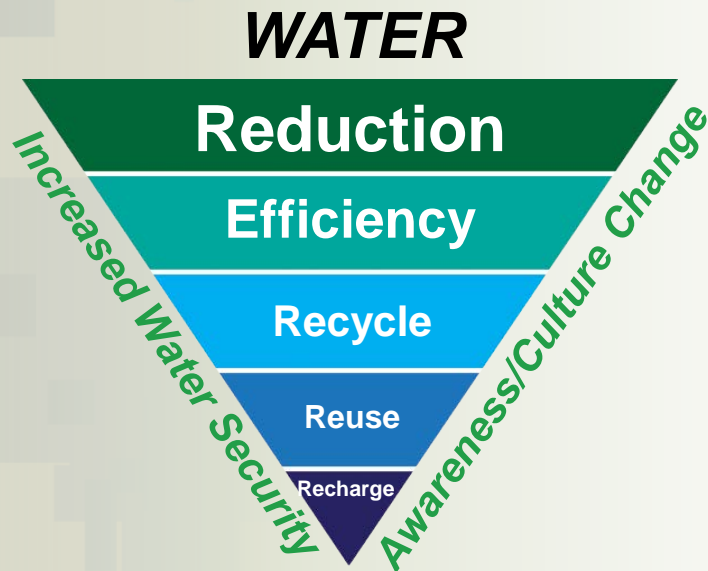
- Demand-side energy use reduction
- Energy generation technologies and strategies that also increase energy security
- Building clusters served by smaller central utility plants and microgrids
- Flexible implementation strategies







# Net Zero Water



## Net Zero WATER:

Reduce overall water use, regardless of the source; increase use of technology which uses water more efficiently; recycle and reuse water, shifting from potable water use to non-potable sources as much as possible; and minimize inter-basin transfers of any type of water, potable or non-potable

## **Holistic Approach Includes:**

- Water conservation and efficiencies
- Water reuse strategies
- Water security and reliability strategies





# Net Zero Waste



## Net Zero WASTE:

Reduce, reuse, recycle/compost, and recover solid waste streams, converting them to resource values, resulting in zero landfill disposal

## Holistic Approach Includes:

- Improved purchasing practices
- Recognition that waste is a resource
- Increased recycling and composting
- Energy recovery



# Army Directive 2014-02: Net Zero Installations



SECRETARY OF THE ARMY  
WASHINGTON

28 JAN 2014

MEMORANDUM FOR SEE DISTRIBUTION

SUBJECT: Army Directive 2014-02 (Net Zero Installations Policy)

1. References:

- a. Energy Independence and Security Act of 2007, Public Law 110-140.
- b. Energy Policy Act of 2005, Public Law 109-58.
- c. Executive Order 13514 (Federal Leadership in Environmental, Energy, and Economic Performance), October 5, 2009.
- d. Executive Order 13423 (Strengthening Federal Environmental, Energy, and Transportation Management), January 24, 2007.
- e. Department of Defense Strategic Sustainability Performance Plan, FY 2012.
- f. Finding of No Significant Impact, Programmatic Environmental Assessment: Implementation of the Net Zero Program at Army Installations, October 2, 2012.
- g. Programmatic Environmental Assessment: Army Net Zero Installations, Final, July 2012.

2. Purpose. The Army's vision is to appropriately manage our natural resources with a goal of Net Zero in energy, water and solid waste at installations. This memorandum sets policy and assigns responsibilities to strive toward Net Zero at all Army installations where fiscally responsible and in support of mission accomplishment. Net Zero is not a new program, but seeks to build on existing Army sustainability efforts to integrate environmental, energy and green procurement programs. This holistic strategy is targeted to improve management of existing Federal energy, water and solid waste programs with the goal of increasing resiliency where fiscally responsible. Net Zero is a force multiplier that enables the Army to appropriately steward available resources, manage costs and provide Soldiers, Families and Civilians with a sustainable future.

3. Applicability. This policy applies to all permanent Active Army, Army National Guard and U.S. Army Reserve installations, sites and facilities operated and/or maintained by Federal funds in the continental United States (CONUS) and outside the continental United States (OCONUS), hereafter referred to as "installations." This policy does not apply to contingency bases or Civil Works facilities. For the purposes of this policy, the term "Commands" refers to U.S. Army Materiel Command, U.S. Army Installation Management Command, the Army National Guard and the Army Reserve.

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## Purpose

- Sets policy and assigns responsibilities to strive toward Net Zero energy, water, and solid waste at all Army installations, sites, and facilities where fiscally responsible and in support of mission accomplishment.
- Expand roles outside of OASA (IE&E)

## Pilots

- The original Net Zero pilots will continue to strive toward a goal of Net Zero in energy, water, and/or waste by fiscal year 2020. The Net Zero pilots will serve as sources of "best practices" that can be implemented at other installations, sites, and facilities.

## Requirements

- Commands are expected to move toward the Net Zero goals using existing programs and resources, where practical.
- Commands are expected to validate the cost benefit analyses developed by installations for all new Net Zero projects, as applicable.





# Redefined Roles and Responsibilities



- **OASA(IE&E)** - Develop Net Zero strategy and policy, represents Army environmental and sustainability interests, and provides strategic oversight and direction for Net Zero.
  
- **OACSIM**
  - ❑ Quarterly: Update OASA (IE&E) on each Commands' progress, pilot progress, as well as overall Army energy, water, and waste goal performance.
  - ❑ Periodically: Include Net Zero training in existing Army training.
  
- **Commands/DRUS**
  - ❑ Oversee installation, site and facility performance. Continually evaluate and implement energy/water/waste efficiencies, reductions, and reuse to the maximum extent possible.
  - ❑ Hold quarterly conference calls to facilitate information exchange, identify best practices, track progress and publish success stories and lesson learned.
  - ❑ Ensure that installations, sites and facilities report progress quarterly and annually.
  - ❑ Review and certify the accuracy and completeness of data quarterly, and track progress toward Net Zero goals through aggregation of existing data sources.

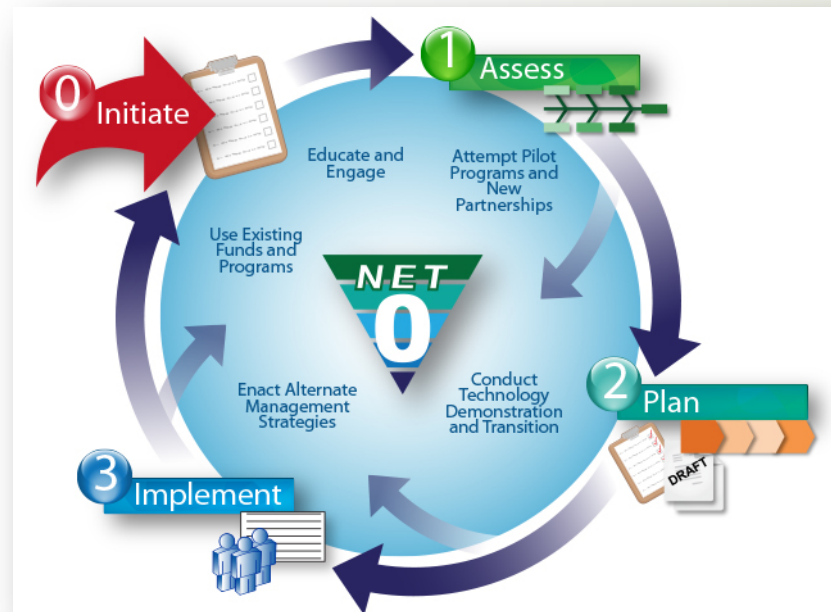




# Net Zero Army Wide



## NZ Implementation Approach: Initiate, Assess, Plan and Implement





# Lessons Learned



- Teamwork and Command support is critical for project execution
- Strategically plan the order in which Net Zero efforts are taken
- Educate yourself about the funding and contracting authorities that are available to initiate energy projects
- Creating a change in culture is key to advancing the Net Zero concept
- Procurement practices affect type & volume of waste generated





# Key Challenges with Implementation



- Lack of supporting data to analyze and develop Net Zero initiatives (e.g., lack of meters, incomplete waste characterization)
- Some Net Zero initiatives may not have positive return on investment
- Challenges with fence-line to fence-line implementation (e.g., privatized utilities, RCI, other tenants)
- Severe fiscal resource limitations restrict the ability of the installation to:
  - ☐ Implement projects
  - ☐ Hire contract personnel to implement the selected actions
  - ☐ Use existing personnel to oversee the implementation
- Continued leadership support, awareness, and engagement





# Best Practices in Net Zero Energy, Water and Waste



## Army Net Zero Best Practices

### Energy · Water · Waste



**Capturing lessons learned and best practices is a crucial step in institutionalizing Net Zero across the Army enterprise.**



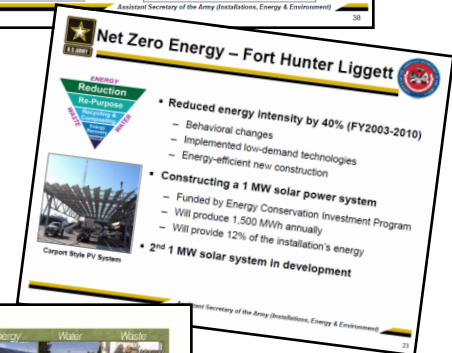
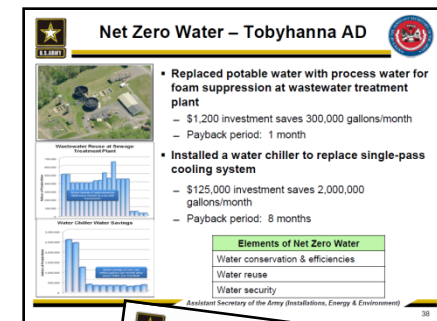




# Internal Collaboration



- Share and document lessons learned
- Build cross-functional Net Zero teams
- Assist each other with challenges
- Conduct monthly calls and periodic progress meetings





# External Collaboration



- DoD – DOE Memorandum of Agreement
- EPA's Office of Research and Development, and ASA(IE&E) Memorandum of Understanding
- GSA leveraged one of our NZ pilots – Fort Carson - to complete EISA requirements





# Emerging Sustainability Issues



The following lists areas or issues while not specifically addressed in the NZ Directive are increasingly emerging as special focus areas of sustainability.

- Develop a Net Zero strategy and policy for contingency bases striving to bring the overall consumption of energy, water, and waste resources down to an effective rate of zero thereby increasing base resiliency
- Enhanced Energy/water security efforts
- Aggressive Green Procurement policies
- Incorporate the following areas into the goals and definitions of Net Zero:
  - ☐ All Waste Including Regulated Hazardous Waste
  - ☐ Training Lands
  - ☐ Alternative Fuels - Transportation
  - ☐ Climate Change – Emissions





# Journeying Towards Net Zero



## Drivers

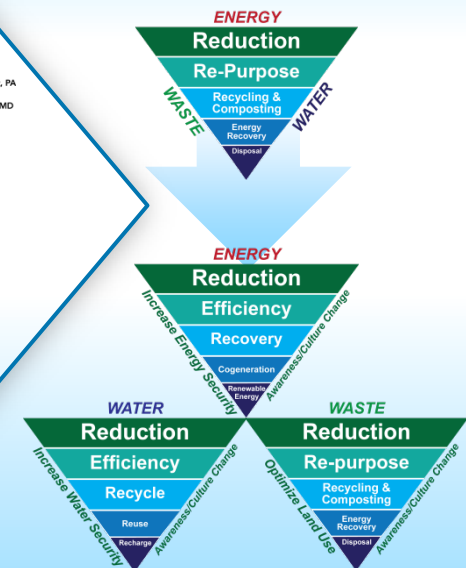
- Energy security, surety, and reliability
- Water scarcity
- Increasing energy prices/  
Fully burdened costs of fuel
- Foreign energy sources
- Environmental concerns
- Federal and DoD mandates
- Improved operational capabilities
- Risk reduction

*Drivers for Change Resulted in Creation of Net Zero Programs for Energy, Water, and Waste*

## 17 Pilot Installations



## Evolution of the Hierarchy





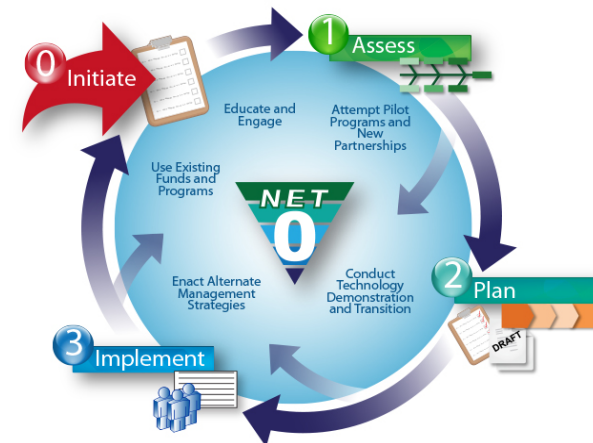
# Next Steps



## Army-wide implementation:

- Identify & institutionalize best practices
- Update AR 420-1 and AR 200-1
- Publish Garrison Commanders' implementation guide
- Support Command reporting

## Refined Concept





# Upcoming Training

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- Module 2: Army Management Approach to Net Zero
- Module 3: Net Zero Energy
- Module 4: Net Zero Water
- Module 5: Net Zero Waste
- Module 6: Net Zero Resources/Tools



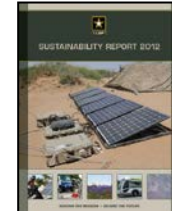


# Questions?



## Army Sustainability Report 2012

<http://usarmy.vo.llnwd.net/e2/c/downloads/269536.pdf>



## Office of the Assistant Secretary of the Army for Installations, Energy and Environment

<http://www.army.mil/asaiee>



## Office of the Deputy Assistant Secretary of the Army, Energy and Sustainability

<http://www.asaie.army.mil/Public/ES/>

## Army Net Zero

<http://www.asaie.army.mil/Public/ES/netzero/index.html>



**Slide 1:** I am Kristine Kingery. I work in the Army Secretariat in the Office of the Assistant Secretary of the Army for Installations, Energy and Environment. I am the Director of Army Sustainability Policy and the Army lead for the Net Zero Installation Initiative. Thank you for tuning in to Session 1 of the Net Zero online training.

**Slide 2:** This is Module #1 - Net Zero 101 and each of the modules – which are listed on the next slide - will begin with a list of topics to be covered such as this one.

First on the list of topics is target audience and learning objectives. Basically – who this training was developed for and why.

I'll go over the history of sustainability from the perspective of the Army.

Issues and successes of two of the installations that pioneered the sustainability movement within the Army – Fort Bragg and Fort Carson.

Legal drivers, goals and the definitions for Net Zero and approaches installations should take to strive towards Net Zero.

What's worked for some installations and how to overcome those challenges that Army installations may still be facing and who's working together to help resolve those and emerging issues.

We'll end with what's next for Next Zero and provide contact information for any questions not answered during the course of this training.

The next slide outlines the topics for modules 2 through 6.

**Slide 3:** Module 2 - provides a review of Net Zero as a Management Approach and addresses the 4 steps: Initiate, Assess, Plan and Implement.

**Module 3** - delves into the holistic approach towards Net Zero Energy following the hierarchy framework of reduction, efficiency, recovery, cogeneration, and renewable energy.

**Module 4** - examines the approach towards Net Zero Water following the hierarchy framework of reduction, efficiency, recycle, reuse, and recharge.

**Module 5** - explores the approach towards Net Zero Waste following the hierarchy framework of reduction, repurpose, recycling and composting, energy recovery and disposal.

**Module 6** - provides information on many Publically Available Tools related to Net Zero with links to their websites, such as the System Advisor Model or SAM, and EPA's WaterSense program that contains a Water-Efficiency Guidance for Federal Agencies



and the Federal Energy Management Programs' Sustainable Facilities Tool for Solid Waste.

**Slide 4:** Although everyone is welcome to learn about the Army's Net Zero Initiative - the target audience for this training is Directorate of Public Works staff such as Master Planners and Program Managers (especially for energy, water and solid waste) or other applicable garrison staff such as the Installation Sustainability Officer.

The main objective of this training is a basic understanding of the Net Zero Initiative—what it is – what it means to you as someone who works on an Army installation, what the requirements are and what are other installations doing? Specifically, what have other Army installations learned from efforts they've initiated under the auspices of Net Zero and how can you or should you implement the same strategy. You will need to determine what approaches would work best at your installation.

(Speak slow and deliberate) One of the most important things you will learn today is that there is a specific hierarchy of approaches the Army has developed for Net Zero Energy, Net Zero Water, and Net Zero Waste. In other words – the order in which Net Zero approaches should be implemented.

This module will explore the evolution of the Net Zero Installation Initiative from inception to implementation Army-wide. But first we'll go back to the beginning.

**Slide 5:** In order to review where we're at and where we're going, a good starting point would be where we've been – that is, why Net Zero? Where did it originate? Some might say Net Zero is just another name for P2 (or Pollution Prevention). Although the two share some of the same goals like pollution prevention and source reduction – it's in the approach that the two initiatives are quite different. In the next few slides ask yourself what makes the Net Zero approach different from the P2 Program – we'll come back to that during the Q&A session – for now we discuss the origin of sustainability in the Army.

Pause for effect.

Forces Command or FORSCOM Installations saw a tremendous growth in sustainable practices during the 1990's – although Army-wide they didn't quite call it that yet. Pollution Prevention or P2 programs were the driving force behind these initiatives that resulted in reduced pesticide use, a reduction in the quantity and toxicity of hazardous waste generated, improved waste diversion rates and decreased water use.

At the start of the new decade, armed with all their successes and accolades and with help from a few key installations and key staff HQ Forces Command initiated the development of the Installation Sustainability Program. Forward-thinking leadership and

the efforts of talented staff at the installation level drove the concept of sustainability from the “bottom-up”. Astute leadership at the Army HQ and DoD level helped to create the concept of sustaining the mission – from the “top-down approach”. Despite all of the successes realized by P2 initiatives, all the money saved and costs avoided and good PR for the Army - there was a growing concern amongst Army leadership about environmental issues and perceived constraints having a negative impact on training missions. The red flag for some was an incident in which community concerns halted training at a National Guard installation. Instead of buckling to the pressure from either side – Army leadership developed an integrated compromise. This compromise – a document which would become the framework for how we view sustainability in the Army today was developed during a Senior Environmental Leadership Conference held in Washington, D.C., entitled ***An Operational Directive and Campaign Plan***. It was signed by the Vice Chief of Staff of the Army on November 17, 2000, and mandated “an integrated strategy, with a defined end-state, that ties resources to objectives and engages stakeholders at all levels—to sustain the mission.”

Next you'll see a couple installation specific examples of the issues that helped drive sustainability and the successes realized because of sustainability initiatives.

**Slide 6:** Ft Bragg began implementing sustainable practices/approaches in 2000 when development outside the installation boundary continued to press the Ft Bragg fenceline to the point where some activities within their drop zone had to be restricted – resulting in a training land shortfall

At the same time, they also had:

- issues w/ endangered species on their training ranges
- Regional air quality issues
- Regional water quantity issues
- & rising energy costs

This led FORSCOM to initiate sustainability planning and in 2000 the 1<sup>st</sup> sustainability planning workshops were held at Ft Bragg.

**Slide 7:** Meanwhile at Fort Carson they were experiencing growing pains of their own and at their inaugural 2002 Annual Sustainability Conference, people from around the community and state helped Fort Carson personnel set 25-year sustainability goals. These goals have evolved over time and have been integrated into the garrison's strategic plans which are updated by the garrison commander to reflect multiple objectives related to soldiers, families, and the workforce and Fort Carson's training mission. The dynamics of the Annual Sustainability conference have changed too. Fort

Carson transferred management of the conference to a local non-profit but still provides a military track at the annual event. Fort Carson is making notable progress in reaching its vision of a sustainable future through pursuing achievement of its sustainability goals formulated and adopted during the initial conference in 2002.

- They created a website and published sustainability information – a great resource for soldiers and civilians and at the time ISO 14001 compliant for Environmental Management Systems (EMS) – which at one time was combined with sustainability to form their SEMS. The website has since evolved into a ‘Sustainable Fort Carson’ website managed under the Installation’s PAIO (Plans, Analysis and Integration Office) by the Installations Sustainability Officer and team. Information specific to facility management – recycle operations, master planning, energy and waste operations to include Net Zero initiatives are now published under the DPWs website
- Between 2002-2011, permanent conservation easements were acquired on approximately 25,000 acres of private property through ACUB (Army Compatible Use Buffer-zone program) that extends from 1.5 to 2.0 miles wide along some 23 miles of the Fort Carson perimeter.
- Sustainability planners at Fort Carson foresaw the implications that BRAC would have on installation traffic and have brainstormed, supported and promoted the use of many alternative modes of transportation. Shown here is a Fort Carson Map with shuttle bus routes. Today, Sustainable Fort Carson promotes a “Give a Buddy a Ride” ride-share program.
- Fort Carson was one of the first to purchase and use alternative fuel vehicles.
- Originally purchased with P2 funds – Fort Carson’s solvent distillers and green parts washers are still successfully utilized.

**Slide 8:** We’ve talked about the P2 initiatives era and the roots of Sustainability and Installation specific issues and efforts towards sustainability. By early 2004 – Fort Bragg, Fort Carson and Fort Lewis (now JBLM) had already developed or were in the process of developing their installation level plans and setting their long term sustainability goals. But Sustainability really became official when the Army published the ‘Army Strategy for the Environment: Sustain the Mission – Secure the Future’ in late FY04.

Since then the goals and strategies have changed – a little – but the underlying theme still and will probably always be to appropriately manage the land and resources the American people have entrusted with the Army in a way that enables the Army to accomplish The Mission now and for future generations.

Now we're going to talk about Net Zero and how the concept of Net Zero came to be. Net Zero is not a replacement for 'sustainability'. Sustainability reaches into everything. It is the overarching way of managing and planning for....just about everything in a way that enables future generations to enjoy the same resources. Net Zero is based on that same concept but in a less broader sense. The Army's Net Zero Initiative (for now) focuses on managing energy and water resources in a sustainable way and taking steps to reduce the sources of waste generation.

Next slide discusses the forces that helped drive Net Zero.

**Slide 9:** As the Army continues to manage our installation footprint, we are striving to balance overlapping and sometimes competing objectives. For example, we are balancing our goal to increase energy security, surety, and reliability with goals to reduce fuel costs, foreign sources of energy, and environmental concerns. We are also striving to meet or exceed the performance targets established in Federal mandates including EO 13514 Federal Leadership in Environmental, Energy, and Economic Performance, the Energy Policy Act of 2005 or commonly referred to as EPAct05 and the Energy Independence and Security Act of 2007.

Installations and surrounding communities are experiencing increased power outages due to the impact of natural disasters and a vulnerable electrical distribution system. As depicted in the graph on the lower left, in the last ten years, we have seen over a four-fold increase in power interruptions on our Army installations.

In the past year, between 30% and 50% of the contiguous United States experienced drought conditions.

Energy supply shortfalls, coupled with water scarcity, represent a strategic vulnerability for the Army – increasing risk to our mission, our pocketbook, and our reputation. Ensuring energy and water security, through increased efficiencies and diligent management of resources, reduces this vulnerability.

**Slide 10:** The intent of the Army's Net Zero (NZ) Initiative originated from the Department of Energy's (DOE)s Net Zero Energy Installation (NZEI) Task Force which was created as a result of EO 13514. DOE was on point to work collaboratively with the DoD and installations from each service to implement a pilot program to study Net Zero *Energy* Installations. The concept of Net Zero Energy was first developed in the context of a typical house – where all energy needs are provided by renewable energy sources generated on, in or near the home. The concept expanded to communities, campuses, and military installations.

Leveraging efforts and progress made with the DOE-DoD NZEI initiatives, the Army took a broader approach, expanding beyond energy to incorporate water use and solid

waste generation, and by February 2011, multiple interested installations had nominated themselves to take part in the Army's NZ Pilot Installation Initiative. On 19 April 2011, the Army identified 17 pilot installations striving to bring the overall consumption of resources within their respective assigned category down to an effective rate of zero by 2020. The pilot installations vary in size, both in population and physical acreage, are geographically diverse, and include representation from all Army Commands. The pilot installations have and will continue to serve as model communities for sustainability and quality of life while the Army takes an even broader approach by decentralizing NZ and applying the NZ concept to all Army Installations.

Appropriately managing our natural resources and complying with Federal mandates is a challenge that the Army has been addressing through technologies, policies, and initiatives, such as Net Zero. But in order to leverage Net Zero concepts to meet all these challenges – we had to define Net Zero. And then redefine Net Zero as you will see on the next two slides.

**Slide 11:** What you are viewing right now was taken from a presentation slide created in mid 2012 at the onset of Net Zero when the Army was still defining what it means to be a Net Zero installation. At the time – there was only one Net Zero Hierarchy which served to prioritize approaches for all three – Net Zero Energy, Net Zero Water and Net Zero Waste. As the Initiative progressed, it became clear that the Net Zero hierarchy applies differently to energy, water and waste, and alternate versions of the Net Zero hierarchy were needed to capture differences. The Net Zero hierarchy, the framework for the Net Zero strategy, was refined into subordinate hierarchies for each area of Net Zero. The hierarchies together articulate an overall approach that is not only consistent across installations, but also allows for unique solutions to emerge for each installation in accordance with their specific circumstance.

Also the definitions needed to be refined. Just how the Net Zero Hierarchy and definitions were refined will be discussed a little later. Please take a moment to review the original definitions and when we revisit with the new definitions – test yourself to see how quickly you can identify the changes – which range from subtle nuances to major revision.

Now we're going to cover the initiative that jumpstarted the Army's Net Zero efforts – the Army's Net Zero Pilot Installation Initiative

NOTE – definitions that are shown on the slide are repeated here below, in the event its decided to 'read along' with the Trainee

The original Net Zero Hierarchy – Inverted triangle and Army's Definitions of Net Zero:

The Net Zero approach is comprised of five interrelated steps: reduction, re-purpose, recycling and composting, energy recovery, and disposal. Each step is a link towards achieving Net Zero.

- A **Net Zero Energy** Installation as producing as much energy on site as it uses, over the course of a year.
- A **Net Zero Water** Installation limits the consumption of freshwater resources and returns water back to the same watershed so not to deplete the groundwater and surface water resources of that region in quantity or quality.
- A **net zero waste** installation is an installation that reduces, reuses, and recovers solid waste streams, converting them to resource values with zero solid waste landfill.
- A **net zero installation** is one which applies an integrated approach to management of energy, water, and waste to capture and commercialize the resource value and/or enhance the ecological productivity of land, water, and air.

**Slide 12:** The Army announced the Net Zero Initiative in October 2010 at AUSA. After a call for volunteer installations in February 2011, the Army identified 17 pilot installations on 19 April 2011.

These pilot installations are striving to bring the overall consumption of resources within their respective assigned category of energy, water, and/or waste down to an effective rate of zero by 2020. The pilot installations vary in population, are geographically diverse, and include representation from all Army Commands. They range in physical acreage from Fort Bliss with over 1,000,000 acres to Fort Detrick with less than 1,500 acres.

They also support a wide range of Army missions, from research and testing at Kwajalein Atoll, to education at West Point, to innovation at Tobyhanna Army Depot, and to training, deployment and sustainment of units and teams for combat at Fort Carson. The pilot installations have and continue to serve as model communities for sustainability and quality of life.

As you can see from the map, the following were selected for the Army Net Zero Pilot Installation Initiative: the green dots represent NZ Energy pilots, the blue dots represent the NZ Water pilots, and the red dots represent the NZ Waste pilots. There are some overlaps at pilots, for example, Fort Detrick is both an Energy and Waste pilot installation.

**Slide 13:** The Army selected the pilot installations based on qualitative and quantitative criteria. These criteria included:

- Command or installation-level support to pursue a Net Zero status
- Constraints or vulnerability of current natural resources
- Impact on mission critical objectives
- Energy security needs
- Installation expertise
- Installation cost sharing capability
- Resource costs
- Project development capabilities acquired from past, current or programmed conservation, efficiency, recycling, recovery, or generation projects
- Local regulatory climate

The graphics depicts the timeline of the selection process, beginning with the development of the criteria, “Participation as a Pilot Army Net Zero Installation” memo, data collection and ending with a review board and finally the announcement of the pilots.

**Slide 14:** This slide identifies specific activities and actions taken to implement Net Zero at our pilot installations, including establishing a baseline, assessing potential, and integrating results into existing programs. All activities and actions are based on collaboration.

Establishing a baseline involves completing an energy audit, conducting a water balance assessment or a material flow analysis and waste characterization study.

Assessing potential for future activities involves conducting a renewable energy audit, identifying water re-use opportunities, or identifying additional material re-use and waste diversion opportunities.

Net Zero efforts tie these all together. They include project lists and actions to meet a pilot installation’s Net Zero goals by fiscal year 2020. Results are then integrated into energy and water master plans, as well as solid waste management plans, which document activities the Army is already doing.

The next charts describe the roadmaps at our pilot energy, water and waste installations.



**Slide 15:** The Net Zero Energy Roadmaps developed for the pilot installations identified renewable energy technologies and potential project opportunities and actions to be taken to meet the installation's respective Net Zero goal by FY2020. Each Roadmap included a recommended project list for FY13-FY20, including the following:

- Energy efficiency improvements (e.g., bldg. envelope, HVAC equipment, lighting)
- Opportunities for waste heat recovery and CHP
- Renewable energy projects (such as solar hot water, solar PV, geothermal, wind, or biomass)

As the roadmaps are implemented:

- The installation should see a steady reduction in energy consumption
- & a steady increase in renewable or alternative energy technologies

This figure is from the Sierra AD energy roadmap & shows the sequencing of projects through FY2020 to reach net zero.

**Slide 16:** A Net Zero water roadmap builds a strategic framework from which the sites can implement initiatives to help drive them towards Net Zero. The roadmap, like that for energy, will contain specific projects, sequenced over several fiscal years, with the progress that each project will make toward Net Zero clearly identified.

Based on results from a water balance survey, Net Zero water projects are identified that will have the greatest affect on overall water demand reduction and will move the installation toward Net Zero.

Projects will include a mix of efficient technologies and projects that target alternate water sources that will replace the use of freshwater resources. There will be an emphasis on demand reduction and then alternate water projects. The installation's master planning activities will be part of the formulation of the roadmap so that the installation's current plans are well integrated into the Net Zero program.

This example is from Fort Carson's Water Roadmap.

Annual potable water consumption at Fort Carson will be reduced by 47% from FY 2012 if the recommended Water Conservation Measures are implemented and the reclaimed water system is expanded. However, this reduction in potable water use and expansion of the reclaim system does not enable Fort Carson to achieve its net zero water goal, which is to reclaim water through the WWTP equal to or greater than the amount of potable water that is supplied to Fort Carson by FY 2020.

To meet this ultimate goal, Fort Carson will have to consider direct potable reuse. As Fort Carson's population grows through FY 2015, wastewater discharge will increase to 424 Mgal annually. Of this total, 209 Mgal will be reclaimed during the irrigation months of April through October after completion of the reclaim expansion project. During the non-irrigation months, Fort Carson will have a capacity of 215 Mgal of water to reclaim as direct potable reuse. The total capacity to reclaim wastewater effluent will be essentially equivalent to the potable water use at Fort Carson, which meets their net zero water definition.

**Slide 17:** The first component of a Net Zero Waste Roadmap is a Material Flow Analysis that looks at "outputs" (which is the current waste disposal) as well as "inputs" (like purchasing data). This links the volume of waste generated by activity with the source of that waste in the supply chain.

The installation's priority waste streams are also identified in the MFA.

The Roadmap develops strategies & specific projects for reducing or eliminating those waste streams, including:

- Improved purchasing practices
- Expanded re-purposing / re-use strategies
- Additional waste streams targeted for recycling or composting
- Potential energy recovery technologies

Over the past three years, collaboration has stood out as a crucial ingredient in the recipe for achieving Net Zero.

**Slide 18:** As previously discussed - As the Net Zero Pilot Installation Initiative progressed, it became clear that the Net Zero hierarchy applies differently to energy, water and waste, as reflected in the alternate versions that were refined into subordinate hierarchies for each area of Net Zero. The hierarchies together articulate an overall approach that is not only consistent across installations, but also allows for unique solutions to emerge for each installation in accordance with their specific circumstance. Common to all hierarchies are Reduction and Awareness/Culture Change.

The definitions of Net Zero Energy, Water, and Waste have also evolved and as the Initiative progressed, it became clear that the Net Zero hierarchy, which is the framework for the Net Zero Strategy, applies differently to energy, water and waste.

**Slide 19:** The Net Zero energy definition was clarified to emphasize the need to reduce overall energy use, increase efficiency, and implement recovery & co-generation

opportunities, replacing the remaining energy with renewable energy. This refined definition evolved from the original Net Zero Energy Definition: produce as much energy on site as it uses over the course of a year.

The Net Zero Energy hierarchy focuses first on energy reduction through conservation, followed by energy efficiency. Once energy use is reduced as much as possible and energy efficient technologies have been implemented, the hierarchy dictates that energy recovery and cogeneration be investigated. Remaining energy loads are to be met with the use of on-site renewable energy sources. This approach enables a Net Zero Energy installation to produce as much renewable energy as it uses over the course of a year.

Note that we do not START with renewable energy. The reason Reduction is at the top of the inverted triangle is because reducing the amount of energy consumed is the first step in any Net Zero effort. Renewable energy is the bottom, and smallest portion, of the triangle. Spanning all of the energy hierarchy steps are “Increased Energy Security” and “Awareness/Cultural Change.”

Our installation energy managers understand that achieving a resilient, Net Zero installation requires a systems-of-systems, holistic approach. Holistic approaches to achieving Net Zero Energy include dramatic demand side energy use reduction; the right mix of energy generation technologies and strategies that also increase energy security; building clusters served by smaller central utility plants and microgrids; and flexible implementation strategies accounting for technology innovations and mission changes.

**Slide 20:** The Net Zero Water definition mirrors the revised hierarchy.

The Net Zero Water hierarchy is similar to that of Net Zero Energy. It begins with the reduction of water use from all sources, followed by improved efficiency. Installation decision makers identify the largest water uses and seek to perform the same functions with less water. These efforts are a top priority as they should have the greatest effect on reducing overall water use. This refined definition evolved from the original Net Zero Water Definition: limits the consumption of freshwater resources and returns water back to the same watershed so as not to deplete the groundwater and surface water resources of that region in quantity and quality over the course of a year.

Next, installations maximize water recycling and reuse to reduce the demand on fresh water sources, protecting surface or groundwater sources for future use. They shift from potable water use to non-potable sources as much as possible, and minimize inter-basin transfers of any type of water.

The final step in the hierarchy is focused on recharging the aquifer. The goal of a Net Zero Water installation is to recharge as much water back into the aquifer as it withdraws.

Spanning all of the water hierarchy steps are “Increased Water Security” and “Awareness/Cultural Change.” We acknowledge that achieving Net Zero energy or water does not ensure energy or water security, and that additional steps must be taken to achieve both goals. The second overarching action emphasizes the need to integrate awareness and culture change into all Net Zero efforts.

Holistic approaches to achieving Net Zero Water include water conservation and efficiencies; water reuse strategies, including grey water and purple pipe; and water security and reliability strategies, including alternate water supplies.

**Slide 21:** The Net Zero waste definition was only minimally changed.

The Net Zero Waste hierarchy starts at the top with source reduction building on the Army’s Pollution Prevention programs that have been in place for years and reinforcing that this is the most efficient strategy for minimizing waste and reaching our goal. Re-purposing or re-using waste products and materials is the next most efficient step. This ensures that the complete value of the goods is retained and that the re-used goods are substituted for goods that would have been otherwise purchased new.

Recycling is the next approach but not as preferable as finding a new use for a waste item mostly because recycling requires energy and resources for processing and at best retaining only part of the material value of the goods and materials. Composting is a way to recycle organic food waste.

Energy recovery is only to be considered once all diversion rate goals have been met at an installation. And even then this approach is not very efficient because it only retains the thermodynamic value of the materials used in the goods, and also requires energy and resources for processing.

Holistic approaches to achieving Net Zero Waste include improved purchasing practices. For example, buying less and buying better, such as buying recycled as well as recyclable content, and bio-based products.

The recognition that waste is a resource and implementing take-back policies that match donors with end users is another holistic approach. So is increasing recycling and composting. Joint Base Lewis-McChord is one of our pilot installations that saw first hand the value of turning trash into treasure when it sold the largest pile of compost ever sold through the government’s surplus liquidation site – over 5 million pounds for approximately \$9,000 dollars!

A final step is disposal – but not until every other option is explored - after every bit of waste is recycled, re-purposed, composted, burned for energy recovery then disposal is appropriate.

As installations follow the hierarchy, they see reductions in the amount of solid waste disposed, as the goal of a Net Zero Waste installation is to have zero solid waste landfill disposal.

**Slide 22:** Our collective challenge is to adopt and embed these take-aways into standard activities across all installations, and to continue to partner with communities, other agencies, and industry to achieve the most sustainable and cost effective solutions for all parties involved.

At the end of January 2014, the Secretary of the Army, The Honorable John McHugh, signed the Net Zero Installations Directive to expand the Net Zero Initiative beyond the pilot installations to all permanent Army installations.

The Army's intent is that all installations evaluate the feasibility of achieving Net Zero and then implement, to the maximum extent practicable and fiscally prudent, policies, procedures, and technologies that advance their Net Zero goals.

This slide summarizes the purpose, pilots, and requirements.

The purpose is to set policy and assign responsibilities to strive towards NZ energy, water, and waste at all Army installations, sites, and facilities where fiscally responsible and in support of mission accomplishment. The pilots will still continue to strive towards their original goal and will also serve as sources for “best practices”.

The commands are expected to move towards NZ using existing resources and to also validate cost benefit analyses for new NZ projects.

**Slide 23:** The Directive also refines the roles and responsibilities of each key player.

My office (OASA(IE&E)) develops Net Zero strategy and policy, represents Army energy and sustainability interests, and provides strategic oversight and direction for Net Zero.

OACSIM is responsible for updating my office (OASA (IE&E)) on each Commands' progress, as well as overall Army energy, water, and waste goal performance and including Net Zero training in existing Army Energy Managers Workshops and assist Commands in incorporating Net Zero into other appropriate Army training.

The Army Commands will:

1. Oversee installation, site and facility performance as they strive to exceed the legal, regulatory, Presidential, Department of Defense, and Army policy

requirements for increasing efficiency, reuse, and reducing energy and water consumption, and solid waste generation as cost effectively as possible. Commands will continually evaluate and implement energy/water/waste efficiencies, reductions, and reuse to the maximum extent possible within available funding levels and as new technologies/approaches are proven cost-effective.

2. Hold quarterly conference calls to facilitate information exchange, identify best practices, track progress and publish success stories and lesson learned. Commands will summarize the results in quarterly reports to OACSIM.
  1. Ensure that installations, sites and facilities report progress quarterly and annually on energy, water, and waste per Army policy via existing reporting systems (e.g., Army Energy and Water Reporting System, Solid Waste Annual Reporting-web, Headquarters Army Environmental System).
3. Review and certify the accuracy and completeness of data quarterly, and track progress toward Net Zero goals through aggregation of existing data sources.

**Slide 24:** From the three years we have worked with the pilot installations, using them as our test beds, we have developed an approach to capture the Net Zero concepts.

The key is using existing installation procedures, practices, and systems and strive towards Net Zero as an end state.

The circle graphic captures the overarching approach to implement Net Zero at Army Installations: Initiate, Assess, Plan, and Implement.

**Slide 25:** In the next few minutes I will discuss some of the lessons learned thus far:

Working towards Net Zero requires a diverse and motivated team that includes not only Garrison personnel drawn from public works, master planning, and environmental; but tenants willing to endorse Net Zero goals, as well as support from commands, ACSIM, ASA(IE&E), and subject matter experts. All team members need to be on board and Command support that is made widely known is critical for project execution.

Implementation should first consider reduction, conservation, efficiency as initial low cost/no cost initiatives to provide quick wins towards NZ. Essentially, the first step should be considering options that do not require taking on a financial burden and can be completed quickly. Implementation support is needed after the study/assessment phase, as this can be difficult without proper guidance.

The Key to achieving energy goals is strategic execution & leveraging private sector financing for energy efficiency and renewable power projects. This can be in the form of an Energy Performance Saving Contract or Enhanced Use Lease.

Changing behavior is just as important as implementing a new energy efficient technology. Creating awareness by outreach activities cultivates a more holistic approach so that installation personnel – soldiers, civilians and contractors – stop and rethink about the way their activity affects the energy and water they use and waste they generate.

Procurement practices affect type & volume of waste generated. This is nothing new that was learned. It's just really important and the issue is so large and so ingrained into everyday activities – change seems insurmountable. But there are little changes being made all the time in creating sustainable procurement practices that can lead to more and bigger changes. Take the time to stop and rethink about the purchases made recently for your program. What could have been done better - more efficient - or not purchased at all.

**Slide 26:** From the lessons learned we can see that there are many challenges in the implementation of Net Zero, these challenges include:

- Lack of supporting data to analyze and develop net zero projects hinders decision making. Limited information is available on energy and water use, operations and maintenance costs, and so it can be difficult for installation personnel responsible for Net Zero to make the case for net zero implementation. (For example, lack of meters )
- Many proposed projects do not have positive return on investment (ROI) using standard estimating methods.
- Another complicating factor is that some utilities are privatized and operated by contractors, further limiting access to information needed to identify Net Zero opportunities. Furthermore, the contracts do not require reductions in resource use, so the contractors do not necessarily forward recommendations to achieve Net Zero goals.
- Severe fiscal resource limitations restrict the ability of the installation to implement projects, hire contract personnel to implement the selected Actions, or use existing personnel to oversee the implementation of the selected Actions which are conducted by other entities.
- Lack of leadership support, awareness, and engagement are also significant impediments, as this support is critical to implementation.



**Slide 27:** In the same line of thought, best practices have been identified from the pilot installations that can be used to guide other installations forward. Our office has taken these best practices and is in the process of publishing these documents as it is crucial in institutionalizing Net Zero across the Army enterprise.

Modules 3, 4, and 5 contain details on processes, procedures, and programs at Army installations that have been determined to be a 'Best Practice' in the pursuit of Net Zero.

**Slide 28:** As we can see from the previous slides, collaboration is essential to Net Zero.

The goal is for information learned at one Net Zero pilot installation to be shared with other Army installations.

The Net Zero team at the Headquarter-level hosted monthly collaboration calls and periodic progress meetings with representatives from our energy, water, and waste pilot installations and their Commands. This is being transitioned to the Army Commands at the end of Fiscal Year 14.

**We have also established cross-functional Net Zero teams to share and document success stories and lessons learned, and a best practices document will be published this year as well.**

**These monthly calls and other collaborations are important to NZ progress, as they encourage discussion and sharing of information between installations, as well as with HQDA.**

**Slide 29:** We have also partnered with other Federal agencies, with industry through public-private partnerships, and with municipalities and communities to develop mutually beneficial solutions at the local and regional levels. For example:

1. The Environmental Protection Agency's Office of Research and Development, and ASA(IE&E) signed a memorandum of understanding (MOU) on 28 November 2011, to assist the Army in its Net Zero Initiative.
2. DOE has major national programs in fundamental scientific research; energy research and development (R&D); and nuclear weapons research, development, and production. Much of the work in these programs is conducted through an extensive network of GOCO labs and facilities under UP contracts. Through the Work for Others (WFO) program, DOE can make the highly specialized or unique expertise and capabilities of this network available to support the missions of other federal agencies and non-federal customer needs on a fully reimbursable basis.

3. GSA is required by EISA, Section 491 to complete a demonstration project per year (2009-2014) of green features in a Federal building. GSA reached out to the Army to leverage one of our NZ pilots – Fort Carson.

**Slide 30:** Our current Net Zero Directive specifically excludes Contingency Bases. But we have been working with Contingency Bases– specifically Camp Buehring as a NZ Contingency Base pilot. At the end of FY2014, the Army will issue its ACP that includes Contingency Bases. The Army plans to develop a Net Zero Force 2025 and Beyond strategy and policy for contingency bases striving to bring the overall consumption of energy, water, and waste resources down to an effective rate of zero thereby increasing base resiliency.

Standards for microgrid cybersecurity are coming front and center and may find their way to future NZ Policy issuances

There may come a day when a soldier, Civilian, and/or Contractor are only able to acquire green products in the process of accomplishing the mission at Army facilities. We have a clearinghouse now – an excellent resource where you can find alternative products

Many Installations are already initiating efforts to minimize the Hazardous waste generated on their site and training Lands must be managed in a sustainable way in order to preserve their use for future use.

**Slide 31:** This slide graphically summarizes the Army's journey towards Net Zero.

Through a collaborative process, our pilot installations have made great strides along the Net Zero journey. I am proud with the progress our installations have made and some of the success stories could become the next Army standard as we learn more about increased mission capabilities and cost avoidance achieved from Net Zero.

Our collective challenge is to adopt and embed these takeaways into standard activities across all installations, and to continue to partner with communities, other agencies, and industry to achieve the most sustainable and cost effective solutions for all parties involved.

**Slide 32:** To date substantial progress has been made in the areas of Net Zero energy, water, and waste. From this, best practices and lessons learned have been identified that can be used to guide these and other installations forward. As mentioned earlier, the best practices documents will be published this year.

The Army will start to decentralize Net Zero and embed these practices in standard operating procedures at appropriate Army Commands/Direct Reporting Units and institutionalize an integrated approach of sustainability and resource security to all installation design, planning, service, and investment decisions.

A Garrison Commanders' implementation guide will also be published with the objective of presenting a practical, step-by-step framework to assist Army installations in striving toward Net Zero. This Guide is intended to be used at the installation-level to focus and integrate ongoing management initiatives in the areas of energy, water and waste.

**Slide 33:** Thank you for tuning into Module 1 of the NZ online training NZ 101. The next module will cover Net Zero as a Management Approach – Review of step-by-step approach/philosophy.

The rest of the modules will be an in-depth review of Energy, Water, Waste and the tools needed to achieve NZ.

Net Zero Energy – Energy-specific summaries of the NZ Energy Hierarchy, energy efficiency/renewable energy drivers such as laws, Executive Orders/other issuances, and DoD/Army regulations. Introduction to energy efficiency and renewable energy assessments (including the Energy Initiatives Task Force (EITF) and at what threshold they should be engaged (greater than 10MW)). Capture alignment of current reporting and management requirements, successes, lessons learned and best practices for implementation.

Net Zero Water – Water-specific summaries of the NZ Water Hierarchy, water sustainability/efficiency drivers such as laws, Executive Orders/other issuances, and DoD/Army regulations. Introduction to water balance assessments, ;, residential housing; potable and non-potable water options (purple pipe); and inter basin/ aquifer or climate constraints. Capture alignment of current reporting and management requirements, successes, lessons learned and best practices for implementation.

Net Zero Waste – Waste-specific summaries of the NZ Waste Hierarchy, sustainability/source reduction drivers such as laws, Executive Orders/other issuances, and DoD/Army regulations. Capture alignment of current reporting and management requirements, successes, lessons learned and best practices for implementation.

Net Zero Resources/Tools – Provides information on may publically available tools related to Net Zero.

**Slide 34:** Additional information on Net Zero and other Army energy and sustainability programs and policies is available on our office website.

Thank you for your attention.

## **APPENDIX B**

### **Net Zero Training Module 2 Net Zero Approach**



Appendix B Net Zero  
Training



Appendix B Approach  
Module 2 Speaker Not

## **Appendix B**

*Task 0818, "Army Net Zero Prove Out  
Final Net Zero Training Report*



# Army *Net Zero*

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## Army Net Zero Management Approach

Assistant Secretary of the Army  
(Installations, Energy and Environment)



# Module 2 – Net Zero Management Approach

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- Target Audience and Learning Objectives
- Net Zero Hierarchy
- Collaboration
- Step 0 Initiate
- Step 1 Assess
- Step 2 Plan
- Step 3 Implement
- Army Installation Successes
- Net Zero Army Wide
- Lessons Learned/Challenges





# Learning Objectives



1. The Army's approach to implementing Net Zero
2. Steps to initiate Net Zero
3. Determine data requirements to establish baseline and develop a plan
4. Identify needs and opportunities on your installation
5. Evaluate, validate and implement programs, processes, and projects



# The Army's Net Zero Hierarchy



**Net Zero ENERGY:** Reduce overall energy use, maximize efficiency, implement energy recovery and cogeneration opportunities, and then offset the remaining demand with the production of renewable energy from on-site sources, such that the Net Zero energy installation produces as much renewable energy as it uses over the course of a year.

**Net Zero WATER:** Reduce overall water use, regardless of the source; increase use of technology that uses water more efficiently; recycling and reusing water, shifting from the use of potable water to non-potable sources as much as possible; and minimizing interbasin transfers of any type of water, potable or non-potable, so that a Net Zero water installation recharges as much water back into the aquifer as it withdraws.

**Net Zero WASTE:** Reduce, reuse, recycle/compost, and recover solid waste streams, converting them to resource values, resulting in zero landfill disposal

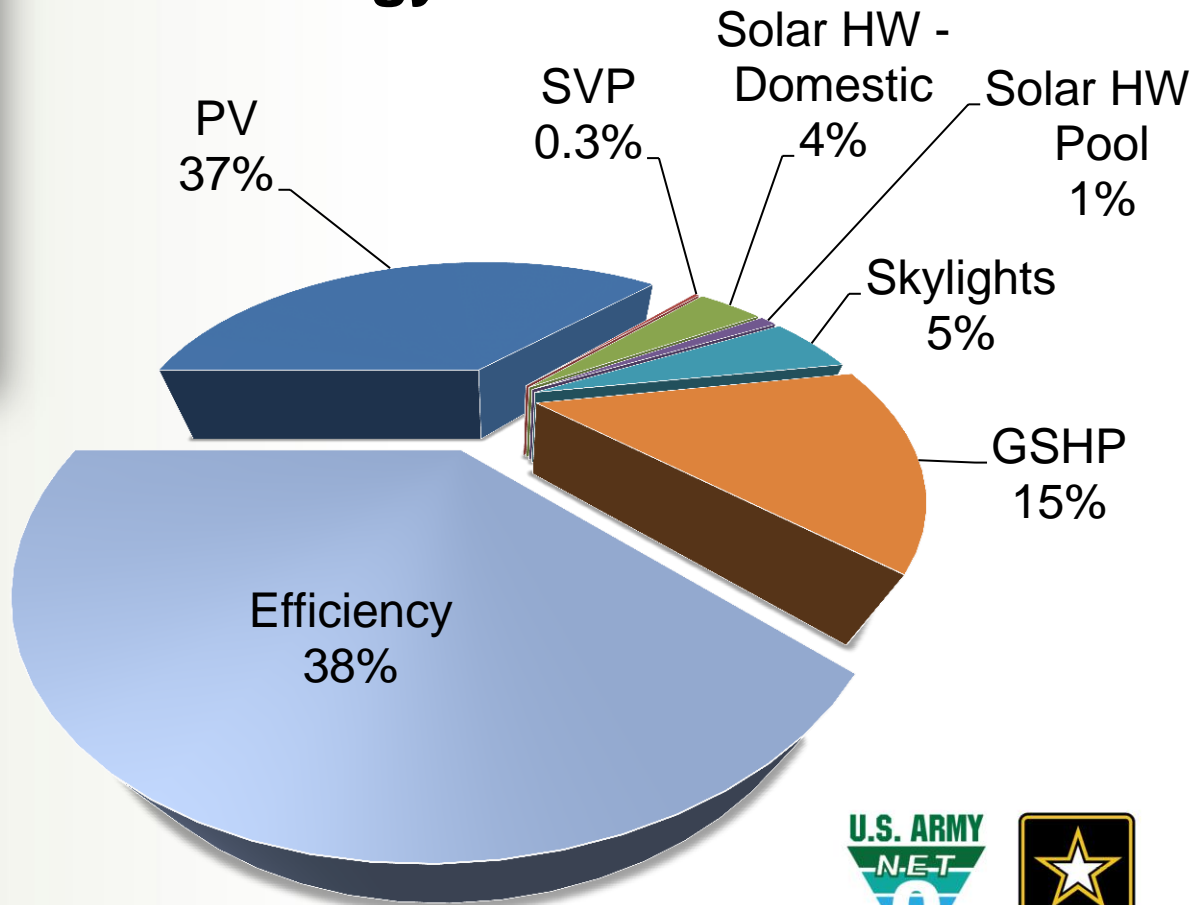


# Net Zero Energy – Ft Hunter Liggett



**Carport PV style system  
at FHL generates  
electricity for the  
installation while  
providing shade for the  
vehicles**

## FHL Net Zero Energy Solution



# Net Zero Water – Camp Rilea



Primary Lagoon  
for WWTP



WWTP rapid infiltration  
basin #1 (of 4)



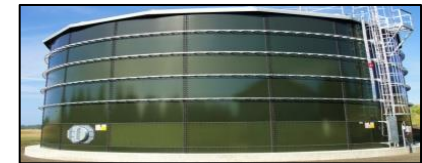
Class A Recycled Water Plant

## ■ Recent efforts:

- ☐ Converted from spray to rapid infiltration basins
- ☐ Recycled water plant converts 65% of effluent to Class A water
- ☐ Water security from 2 new wells and storage reservoir

## ■ Planned efforts:

- ☐ Convert wash rack to use Class A water
- ☐ Expand water reuse from 65% to 100%
- ☐ Replace turf grass with drought-tolerant native species
- ☐ Install low-flow fixtures
- ☐ Implement rainwater harvesting



426,000 gal water supply  
storage reservoir





# Net Zero Waste – Fort Carson



- **Reuse efforts:**

- ☐ Furniture donation program (target: 16,000 of used barracks furnishings)
- ☐ Developing more partnerships for re-use, e.g. Goodwill

- **Recycling efforts:**

- ☐ Recycling all mattresses from barracks
- ☐ Recycling incentives for Units
- ☐ Electronics recycling via Federal Prison Industries (UNICOR)
- ☐ Porcelain collection with City
- ☐ New recycling truck that can weigh containers



# Where to Begin...



## ■ Establish your baseline

- ☐ Complete an energy audit
- ☐ Conduct a water balance assessment
- ☐ Conduct a material flow analysis or waste characterization study

## ■ Assess your potential

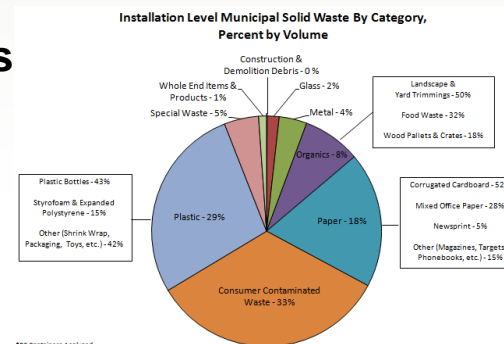
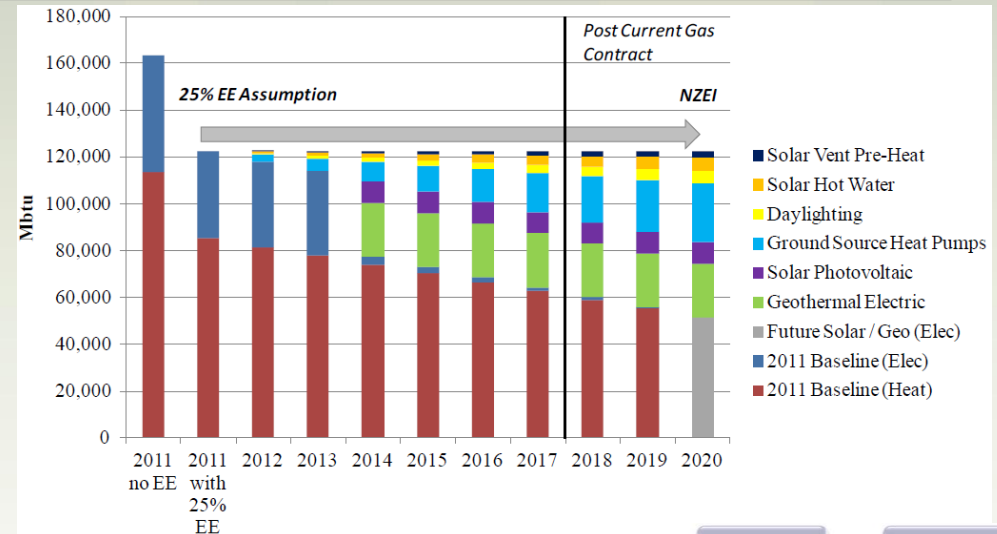
- ☐ Conducting a renewable energy audit
- ☐ Identify water re-use opportunities
- ☐ Identify additional re-use and diversion opportunities

## ■ Integrate the results into existing programs

- ☐ Energy and water master plans
- ☐ Integrated solid waste management plan

## ■ Collaborate

- ☐ Build cross-functional Net Zero teams
- ☐ Join the monthly Net Zero collaboration calls
- ☐ Share and document successes



**Material Flow Analysis**



**Water Balance Framework**

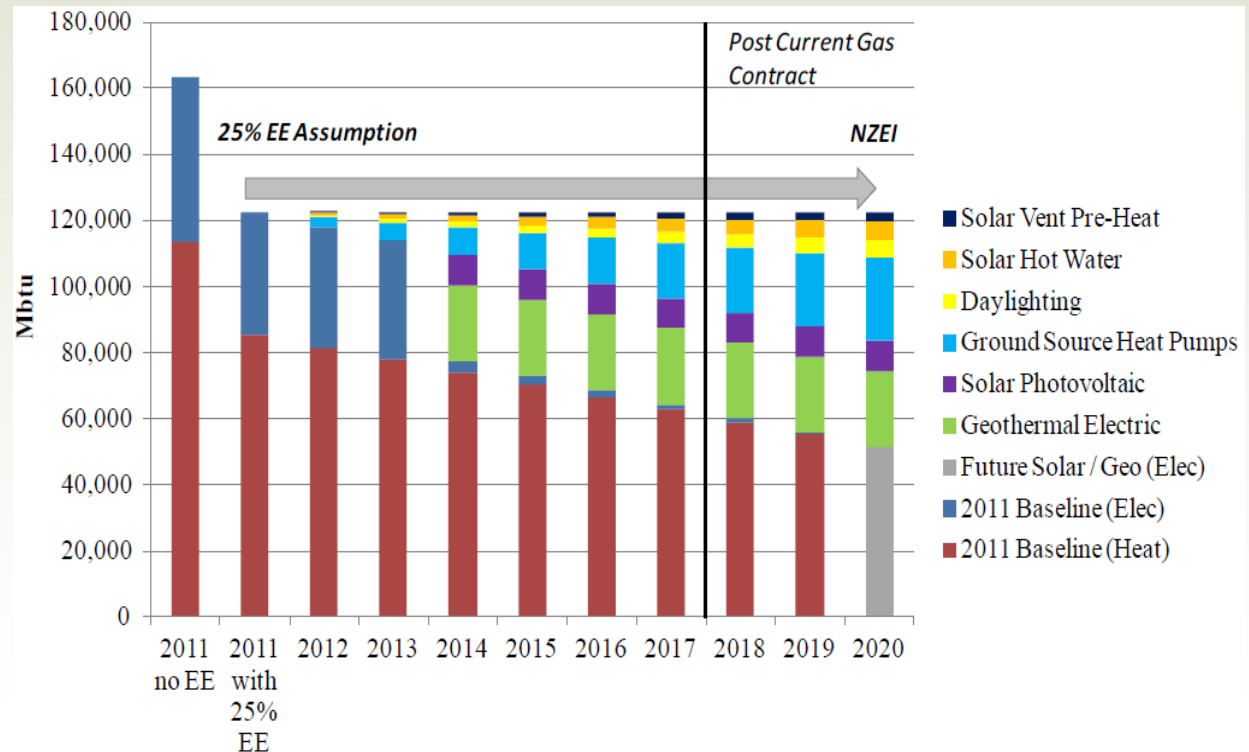


# Net Zero Energy Roadmaps



- Energy Baseline
- Energy Efficiency Assessments
- Renewable Energy Assessments
- Energy Security Assessments
- Energy Project List and Implementation Recommendations

## Sierra Army Depot Load Reduction and Renewable Energy Integration Roadmap



# Net Zero Water Roadmaps



## ■ Water Balance

- ☐ Identify largest end-users
- ☐ Set priorities

## ■ Water Efficiency

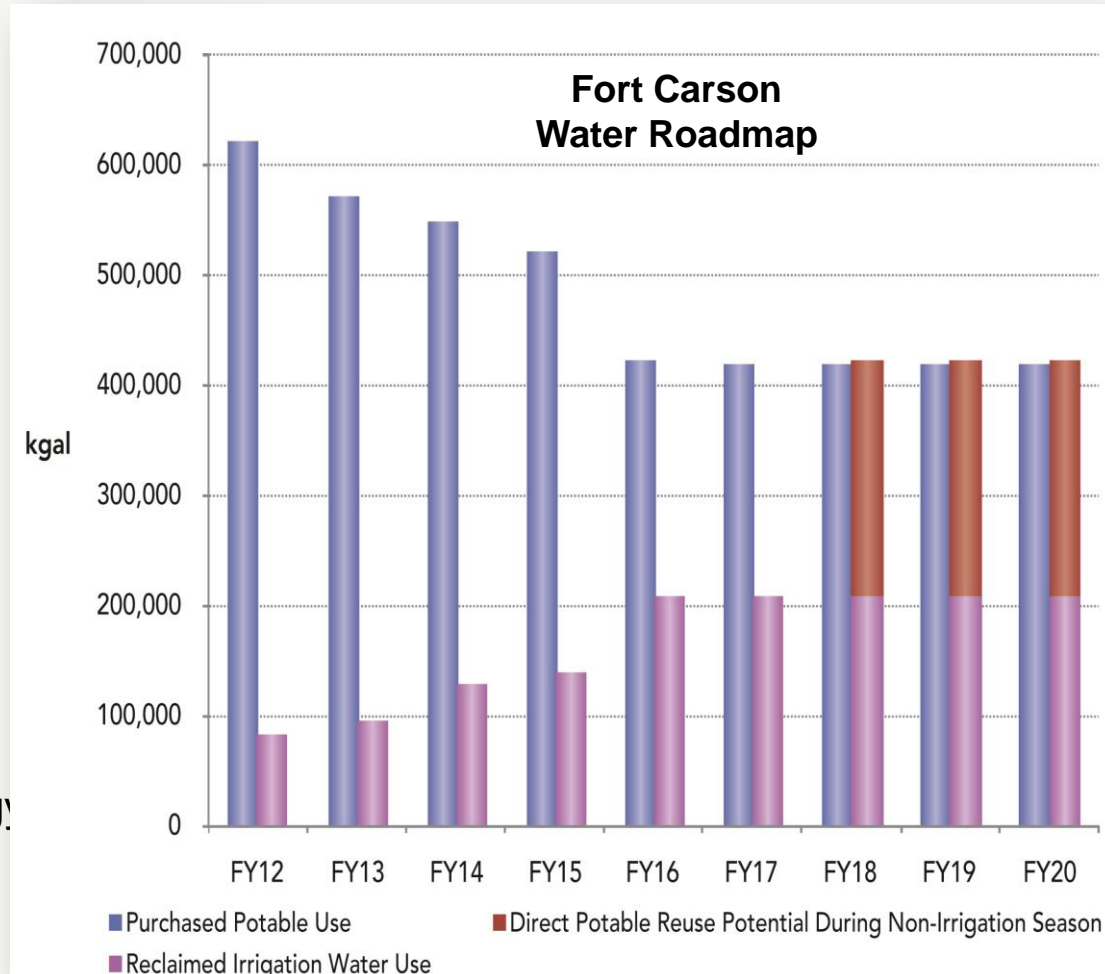
- ☐ Perform LCC analysis on measures
- ☐ Rank order projects
- ☐ Include technology and behavioral changes needed

## ■ Roadmap Workshop

- ☐ Collaborate with site
- ☐ Set priorities
- ☐ Identify funding
- ☐ Determine acquisition strategy

## ■ Roadmap and Master Planning

- ☐ Finalize strategy
- ☐ Incorporate into master planning



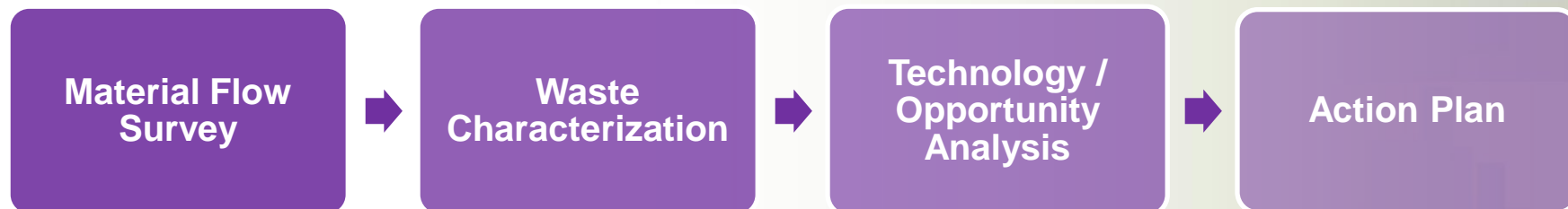
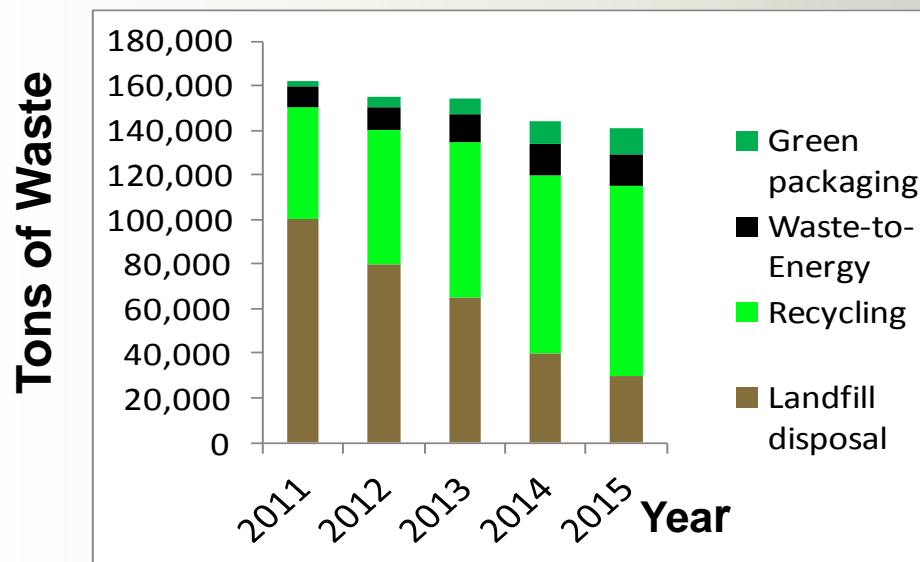


# Net Zero Waste Roadmaps

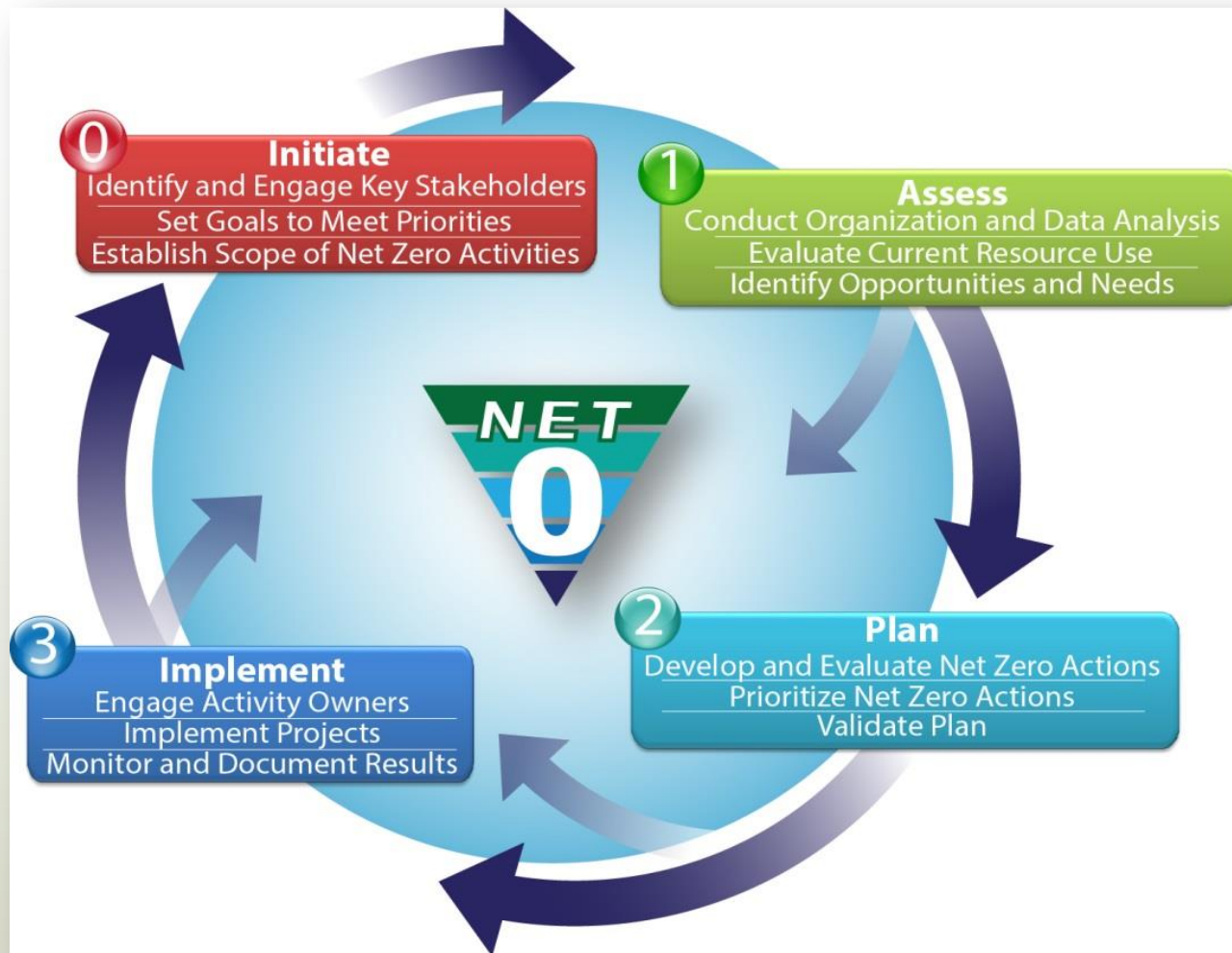


- Material Flow Analysis
- Improved Procurement Practices
- Re-purpose / Re-use Strategy
- Recycling and Composting Strategy
- Potentially Viable Technologies

## Example Installation Waste Profile



# Implementation Framework



# Steps in Net Zero Implementation



STEP		ACTIVITIES
0	INITIATE	IDENTIFY AND ENGAGE KEY STAKEHOLDERS
		SET GOALS TO MEET PRIORITIES
		ESTABLISH SCOPE OF NET ZERO ACTIVITIES
1	ASSESS	CONDUCT ORGANIZATION AND DATA ANALYSIS
		EVALUATE CURRENT RESOURCE USE
		IDENTIFY OPPORTUNITIES AND NEEDS
2	PLAN	DEVELOP AND EVALUATE NET ZERO ACTIONS
		PRIORITIZE NET ZERO ACTIONS
		VALIDATE PLAN
3	IMPLEMENT	ENGAGE ACTIVITY OWNERS
		IMPLEMENT PROJECTS
		MONITOR AND DOCUMENT RESULTS



# Step 0: Initiate



# Step 0: Identify and Engage Key Stakeholders



**Identify and Engage Key Stakeholders**

## **Decision Makers Critical to Net Zero**

Garrison Commander  
Director of DPW  
Utility Planners and Operators (Government and/or privatized)  
Energy or Resource Managers  
Director of DPTMS  
Leads for Major Tenant Organizations  
Director of Resource and/or Budget Management  
Director of Contracting  
Defense Reutilization and Marketing Office  
Sustainability Officer



# Step 0: Set Goals to Meet Priorities



0



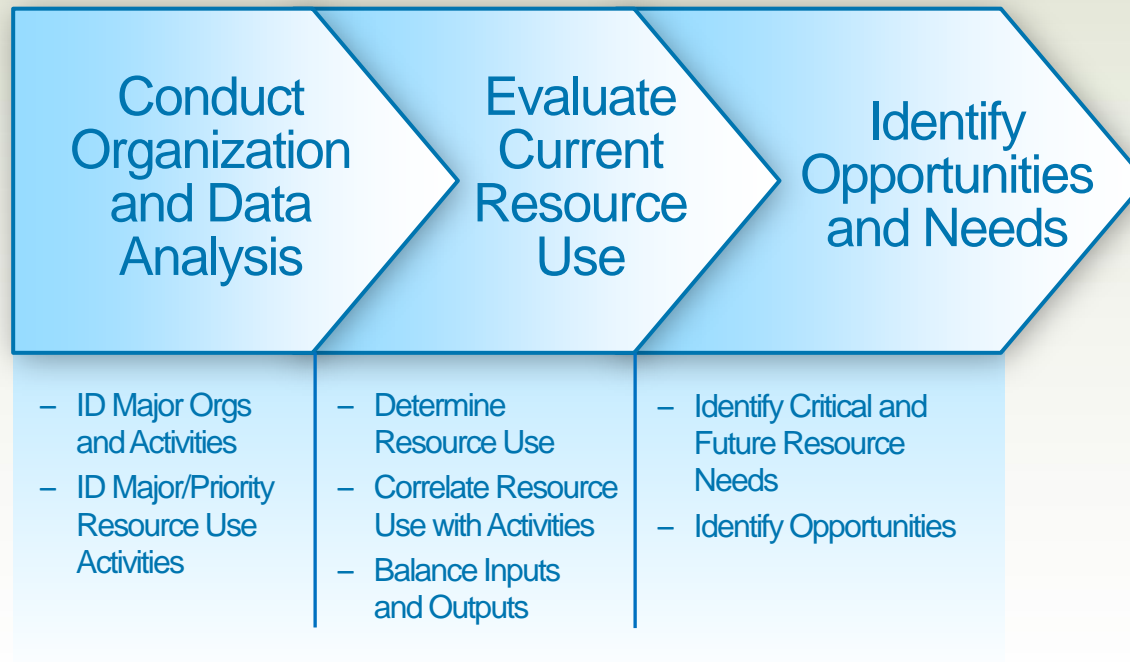
# Step 0: Establish Scope of Net Zero Activities



# Step 1: Assess



## 1

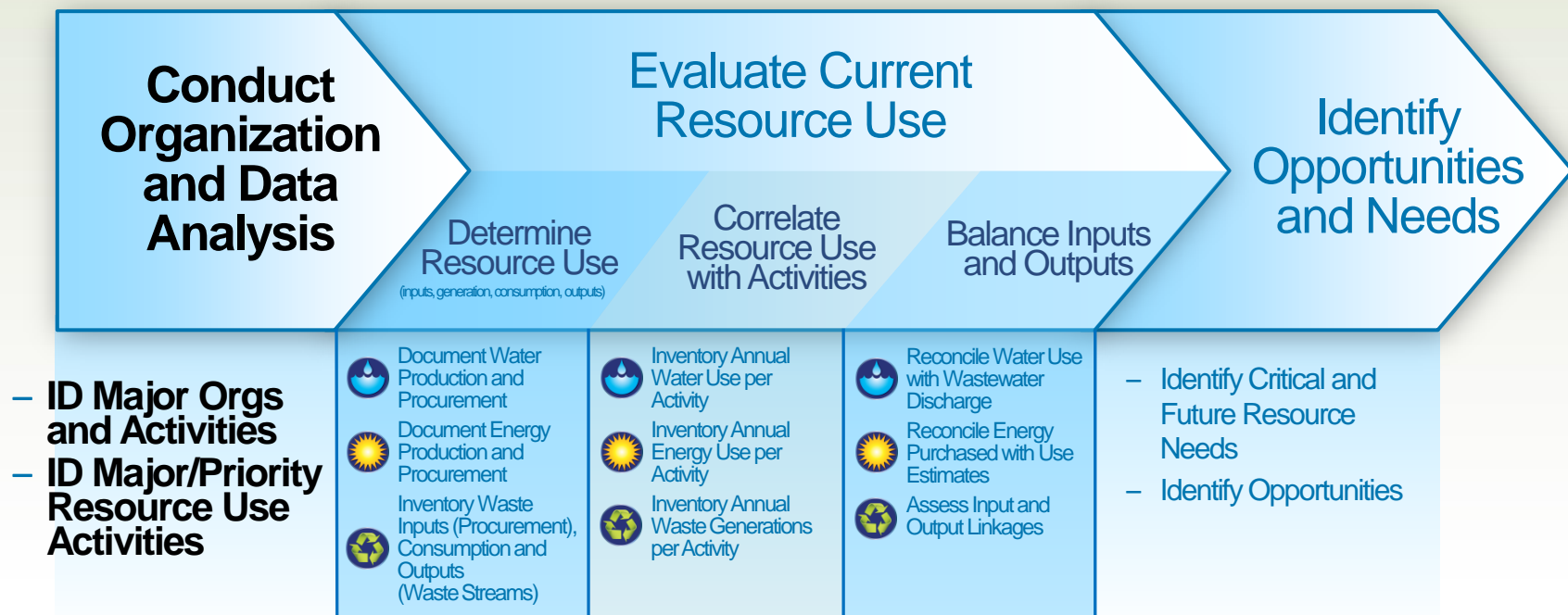




# Step 1: Conduct Organization and Data Analysis



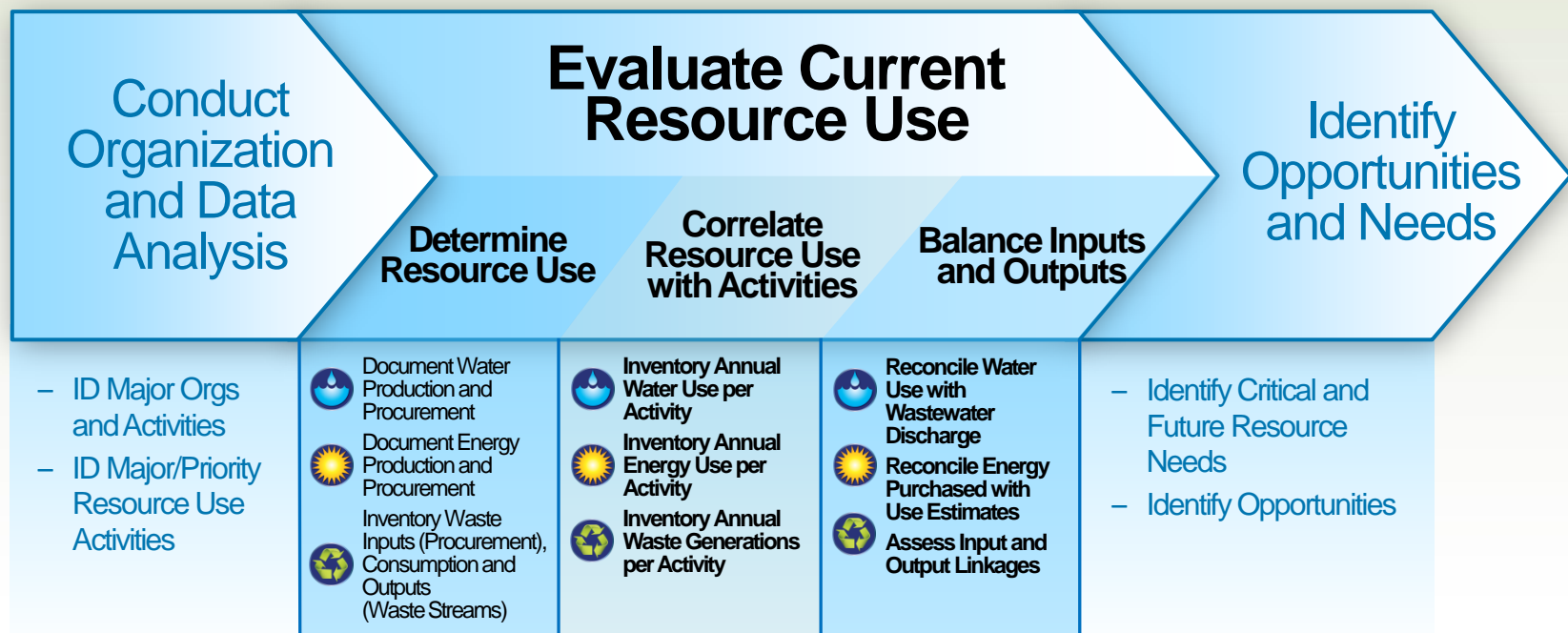
1



# Step 1: Evaluate Current Resource Use



1



# Step 1: Identify Opportunities and Needs



1



# Step 1: Identify Opportunities and Needs (cont)



## 1

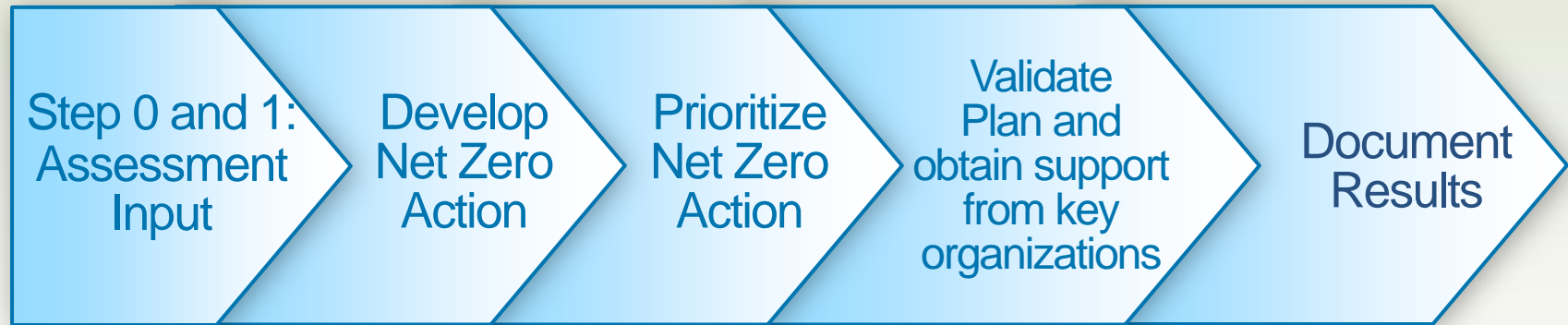
Net Zero Area	Existing Sources of Data and Assessments	Net Zero Assessment Methods
Energy	Energy efficiency audits, renewable energy assessments, Comprehensive Energy and Water Management Plan, Real Property Master Plan	Energy Engineering Analysis Program studies, Net Zero Energy Installation studies/Net Zero Energy Plans, Net Zero Energy Security Assessments
Water	Comprehensive Energy and Water Management Plan, Potable Water System Plan, Water Conservation Plan, Capital Investment Strategy, utility privatization studies, Integrated Natural Resources Management Plan	Water Balance, Net Zero Water Security Assessments
Waste	Installation Solid Waste Management Plan, Qualified Recycling Program plans and reports, waste characterization studies, waste minimization plan, Pollution Prevention Opportunity Assessments, Green Procurement Plan, Environmental Management System	Material Flow Installation Surveys, Activities-based Waste Characterization Studies



# Step 2: Chart/Plan



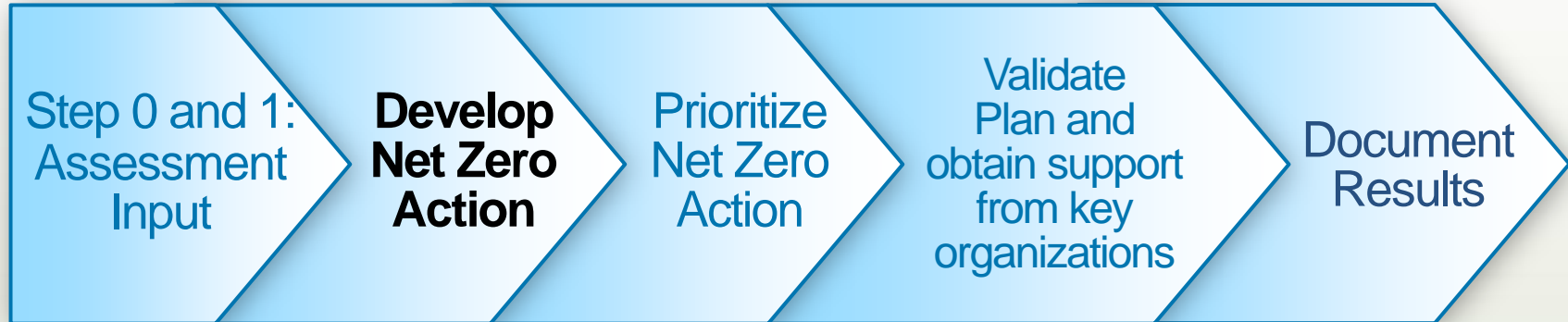
2



# Step 2: Develop Net Zero Actions



## 2



Utilize Results from  
Assess Step; Solicit  
Input from Major  
Organizations



## Step 2: Develop NZAs (cont.)



# 2

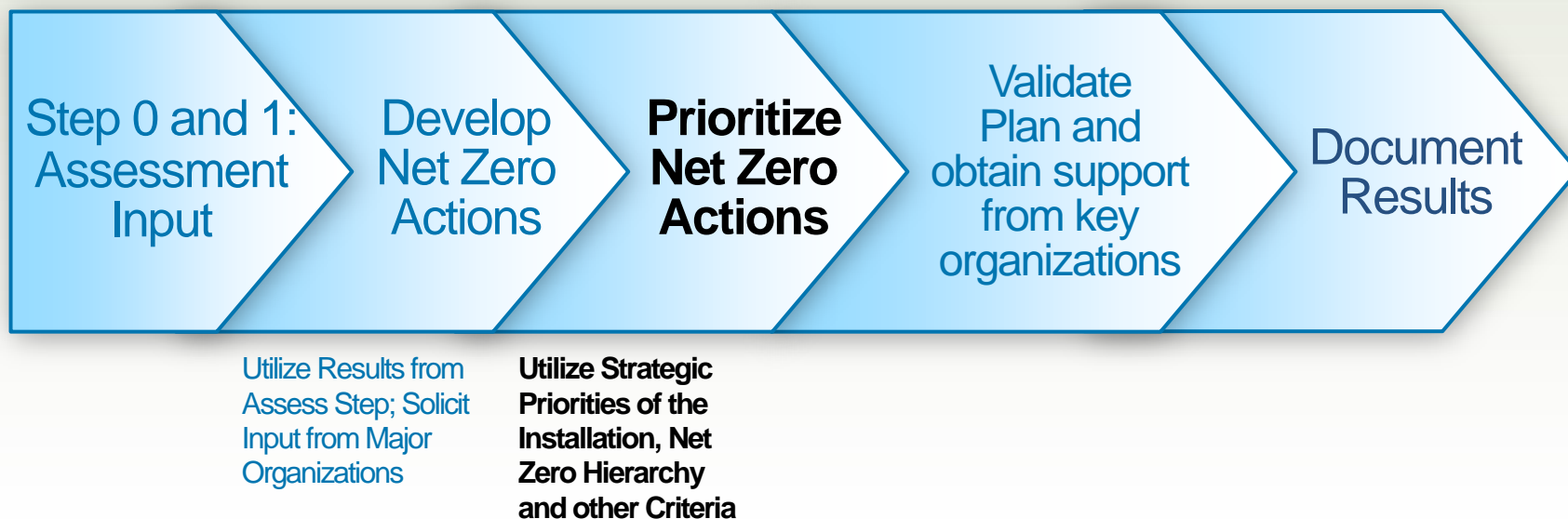
**When developing NZAs, keep the following considerations in mind:**

- ☐ Does it support the mission?
- ☐ Does it address a critical resource issue/requirement?
- ☐ Is it technically feasible?
- ☐ Can existing infrastructure support?
- ☐ Does it reduce resource use or reduce waste sent to landfill?
- ☐ Will it pay for itself? (Life-cycle cost effectiveness)
- ☐ Does it have an advocate/supporter at the installation?
- ☐ Can third party financing be leveraged? Private investment via ESPC, UESC, etc.?

# Step 2: Prioritize List of NZAs



## 2





## Step 2: Prioritize List of NZAs (cont.)



# 2

### Suggested NZA Evaluation Criteria

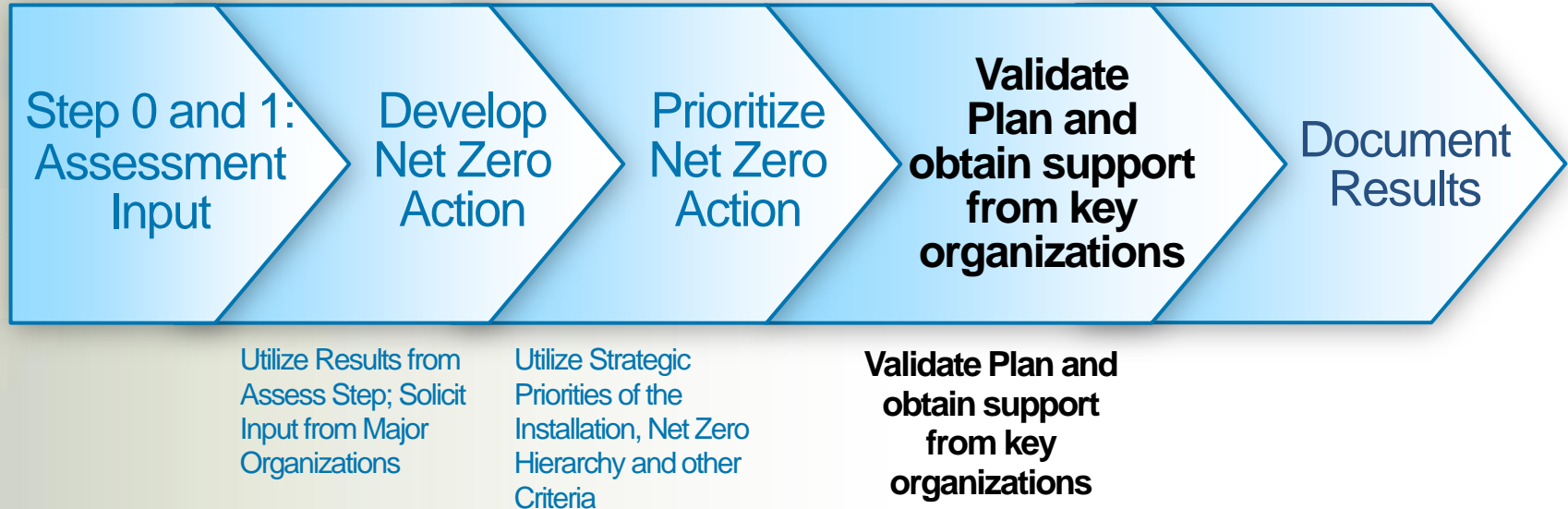
- ☐ Reduction in water use
- ☐ Reduction in energy use
- ☐ Increase in renewable energy supply
- ☐ Increase in alternate water supply
- ☐ Reduction in tons of waste landfilled
- ☐ Reduction in hazardous waste generated
- ☐ Increase in tons of waste diverted
- ☐ First cost
- ☐ Return on investment
- ☐ Life Cycle Cost
- ☐ Reduction in Operation and Maintenance Costs
- ☐ Increase in Energy and/or Water Security
- ☐ Feasibility of implementation



# Step 2: Validate Plan



## 2



# Step 2: Document Results



## 2

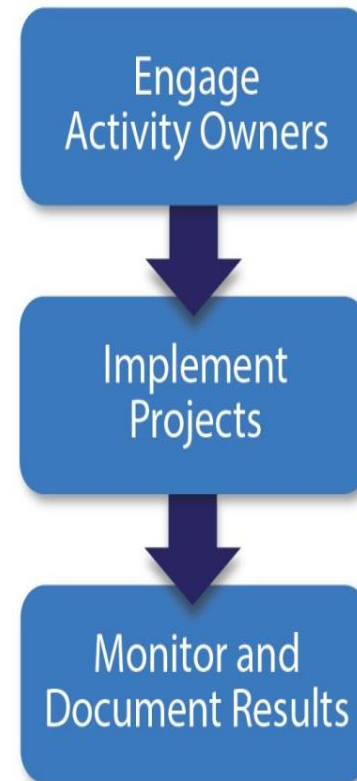


# Step 3: Implement



## 3

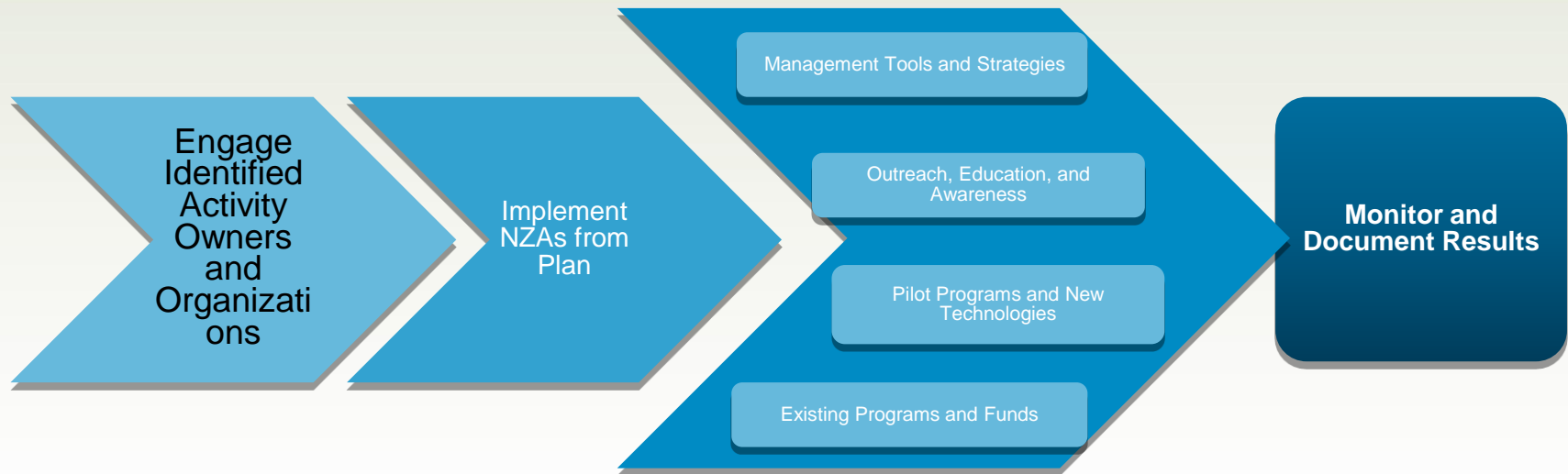
- Should align with Step 0, 1 and 2.
- Major sub-steps:
  - ☐ Engage Activity Owners,
  - ☐ Implement Projects, and
  - ☐ Monitor and Document Results.



# Step 3: Engage Identified Activity Owners and Organizations



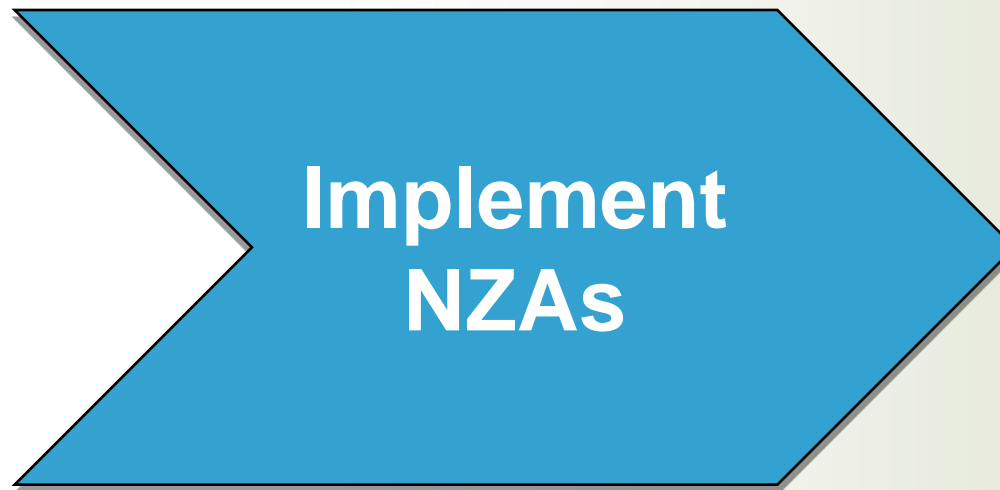
3



# Step 3: Implement NZAs



3



# Step 3: Implement NZAs



3

Management Tools and Strategies

Outreach, Education, and Awareness

Pilot Programs and New Technologies

Existing Programs and Funds



# Step 3: Monitor and Document Results



3





Ref ID	Net Zero Action	NZ Energy	NZ Water	NZ Waste	Mission Impact (Security)	First Cost	Pay Back	SIR	Yrs to NZ Savings Impact	Critical to other NZAs	Likelihood of Success
		Impact on Net Zero Goal	Impact on Net Zero Goal	Impact on Net Zero Goal							
2E	Develop an Energy Management Plan; update annually	1% <= Impact < 10%	0%	0%	no impact	\$0-\$500K	0 to 5 years	1.0-1.2	1-3	supportive of more than one NZA	Highly Unlikely
13E	ESPC Project #5 (Phase II) will include bundled PV projects, water efficiency improvements, and net metering – all the ranges.	10% <= Impact < 30%	Less than 1%	0%	moderate positive impact	0	20 or more years	> 1.2	5-10	not critical to other NZAs	Highly Likely
4M	Establish Net Zero Energy/Water Council; Council will focus on: planning to meet future mission critical infrastructure needs; ensuring future O&M concerns are identified and coordinated with DPW and utility contactors; and tracking Net Zero progress. This could be an expansion of existing	Less than 1%	1% <= Impact < 10%	0%	High positive impact	0	0 to 5 years	1.0-1.2	0 (immediate)	supportive of more than one NZA	Even Odds
28E	ESPC Project #6: ECMs, Solar PV, Retro-commissioning	1% <= Impact < 10%	0%	0%	moderate positive impact	0	20 or more years	> 1.2	5-10	not critical to other NZAs	Highly Likely
3M	Additional Staff dedicated to water and energy management	10% <= Impact < 30%	1% <= Impact < 10%	0%	moderate positive impact	\$0-\$500K	0 to 5 years	1.0-1.2	0 (immediate)	critical to more than one other NZA	Highly Unlikely
22E	Analysis and identification of potential Small-scale Renewable Energy Projects / Ground-Source Heat Pump projects. Follow on project development for funding consideration.	Less than 1%	0%	0%	moderate positive impact	\$0-\$500K	0 to 5 years	1.0-1.2	3-5	not critical to other NZAs	Even Odds
26E	Analysis and identification of potential Solar Hot Water projects. Follow on project development for funding consideration.	Less than 1%	0%	0%	moderate positive impact	\$0-\$500K	0 to 5 years	1.0-1.2	3-5	not critical to other NZAs	Even Odds
93M	Energy Conservation Policy; Implement an energy conservation policy to ensure that energy demands can be met as efficiently as possible.	1% <= Impact < 10%	0%	0%	moderate positive impact	0	0 to 5 years	1.0-1.2	0 (immediate)	critical to more than one other	Highly Likely
50M	Include energy and water conservation requirements in the Installation Design Guide	Less than 1%	1% <= Impact < 10%	0%	no impact	0	0 to 5 years	1.0-1.2	0 (immediate)	supportive of more than one NZA	Highly Likely

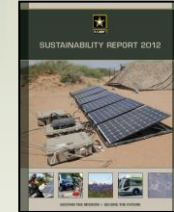


# Questions?



## Army Sustainability Report 2012

<http://usarmy.vo.llnwd.net/e2/c/downloads/269536.pdf>



## Office of the Assistant Secretary of the Army for Installations, Energy and Environment

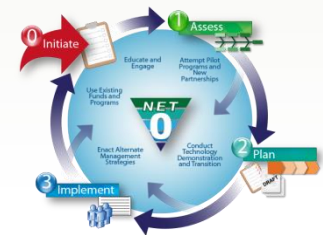
<http://www.army.mil/asaiee>

## Office of the Deputy Assistant Secretary of the Army, Energy and Sustainability

<http://www.asaie.army.mil/Public/ES/>

## Army Net Zero

<http://www.asaie.army.mil/Public/ES/netzero/index.html>



**Slide 1:** I am Kristine Kingery. I work in the Army Secretariat in the Office of the Assistant Secretary of the Army for Installations, Energy and Environment. I am the Director of Army Sustainability Policy and the Army lead for the Net Zero Installation Initiative. Thank you for tuning in to Session 2 of the Net Zero online training.

**Slide 2:** This is Module #2 – The Army's Management Approach to implementing Net Zero. This slide lists the topics. First I'll go over who this training was developed for and what will be accomplished - what you should know by the end of this session.

I discussed the Net Zero hierarchy in detail in the 1<sup>st</sup> module and will revisit the inverted triangle that represents the Army's priority of approaches to Net Zero. I will also explain the importance of collaboration throughout the entire process of implementing Net Zero.

The bulk of this session will provide instructions on the step-by-step process installations have to take to implement Net Zero. The processes covered are not just cookie cutter copies of what private industry is doing in their endeavors toward Net Zero. These steps have been specifically developed for Army installations as a result of working with pilot installations from the Army's Net Zero Pilot Installation Initiative.

First is Step 0 - "Initiate." This step involves identifying and engaging key stakeholders, gathering baseline data and establishing a baseline so that progress can be measured.

Second is Step 1 – "Assess" where a more in-depth data gathering and analysis is conducted on the installations' current resource use, needs of the installations and opportunities that should be considered. These opportunities are listed in order of priority and further evaluated and validated in Step 2 – "Plan".

In Step 3 "Implement" the focus is on the various approaches to implementing Net Zero at an Army installation. Throughout this module the term 'Net Zero Actions' or "NZA's" (used in recent Army Net Zero written reports and other literature) refers to potential opportunities or projects installations evaluate and if proven feasible – are carried through to implementation.

You'll learn about what other installations are doing and how the Army as a whole is supporting Net Zero. Finally, we'll discuss lessons learned and challenges installations facing.

Ok now let's talk about why you're here.

**Slide 3** The objective of this training is to present a practical, step-by-step framework to assist Army installation personnel such as yourself to striving toward Net Zero. The Army recognizes that in an era of declining resources and tight fiscal constraints, our installations must think innovatively about meeting existing requirements. This training,

largely based on the Army's Net Zero Installation Implementation Guide, seeks to facilitate this innovation.

By the end of this training module you should know

1. The a process for implementing Net Zero at your installation
2. Be familiar with what takes place within each of the four (4) steps of that process and
3. Begin to think about what Net Zero action – a project, a new process or modified program –will work best at your installation.

The steps in the Army's approach to Net Zero are

- Step 0 Initiate -
- Step 1 Assess -
- Step 2 Plan
- Step 3 Implement

Now let's revisit the Army's overall approach to meeting Net Zero as defined in the Army Net Zero Directive published on 28 January 2014 the Army's Hierarchy for Net Zero energy, water and waste

**Slide 4:** The definition of Net Zero energy, Net Zero water and Net Zero waste as specified in the Net Zero Directive are listed on Slide 4. Each of the definitions is in line with the approaches listed in order of priority in their associated Net Zero Hierarchy.

[A Net Zero ENERGY Installation is an installation that reduces overall energy use, maximizes efficiency, implements energy recovery and cogeneration opportunities, and then offsets the remaining demand with the production of renewable energy from on-site sources, such that the Net Zero energy installation produces as much renewable energy as it uses over the course of a year. ]

The Net Zero Energy hierarchy requires installations to address energy usage and efficiency first and then evaluate recovery and cogeneration options. To plan for energy security, an alternate energy supply to the utility power grid is crucial. On-site energy production enables each installation to plan for continuity of operations if the grid is unavailable. Commercial Power grids owned and controlled by other than Army are increasingly vulnerable and expose Army operations to risk. The Army's risk mitigation strategy is for on-site renewable energy production, both electrical and thermal energy, but it must be fiscally responsible.

[The Net Zero Water hierarchy requires installations to reduce their water usage first before taking on other Net Zero water approaches. A Net Zero Water strategy requires

us to implement new water efficient technology; recycle and reuse water, shifting from potable water use to non-potable sources as much as possible; and minimize inter-basin transfers of any type of water, potable or non-potable, such that a Net Zero water installation recharges as much water back into the aquifer as it withdraws.]

Water is becoming increasingly more important. Some say it will be more precious than oil in the 21st century. The most critical commodity for China's economy isn't oil, steel or even wheat. It's water. Former UN Secretary-General Boutros Boutros-Ghali predicted the wars of the 21st century would be fought over water. EPA's homeland security research is working on ways to improve water security and to recover from an attack or contamination incident involving chemical, biological, or radiological agents or weapons.

We must identify and prioritize threats to drinking water and wastewater infrastructure, evaluate vulnerabilities, plan for countermeasures to reduce the risk of attacks. The Net Zero Water strategy is intended to improve our water security. Again, as with energy, it is a systems approach using the inverted triangle that requires installations to address the freshwater demand through water efficiency and conservation.

[A Net Zero WASTE Installation is an installation that reduces, reuses, recycles and composts, and recovers solid waste streams, converting them to resource values, resulting in zero landfill disposal.]

Waste avoidance is the most effective reduction method and includes: Changing our procurement practices to eliminate packaging waste where feasible. Implementing take-back policies in contracts (e.g., modular furniture, appliances, packaging) & expanding our efforts to purchase recycled content, recyclable content, & bio-based products.

An estimated 25-50% of an installation's municipal solid waste is compostable – we need to expand composting operations

We're looking at WTE as a future effort, but only after installation have worked thru all the upper levels of the NZ Hierarchy.

OK – now that we've covered the Army's Net Zero Hierarchy of Approaches – this time a little more in-depth – let's see a couple of examples of how it's done at an Army Installation – we begin with Fort Hunter Liggett.

**Slide 5:** Fort Hunter Liggett provides a good illustration of an installation working in line with the Net Zero Hierarchy – they maximized energy efficiency and conservation prior to integrating renewable energy resources. FHL was able to reduce their energy intensity (energy usage per square foot) by 40% from their 2003 baseline. They accomplished this in part through retrofitting conventional street lighting with solar

lighting, replacing incandescent lights with high efficiency T-5 fluorescents, and installing Seasonal Energy Efficiency Ratio (SEER) 14 HVAC systems for on-base housing. FHL also received Environmental Security Technology Program (ESTCP) funding for dynamic window pilot project. These windows will change from clear to tinted on demand in order to reduce building air conditioning loads.

FHL then went on to the renewable energy approach and has successfully installed part of a multi-phased solar array system and they intend to complete the final phases with additional funding support through the Energy Conservation Investment Program (ECIP).

78 electric and 60 smart utility meters were installed which will provide better visibility into energy usage by specific facilities and processes. FHL is also assessing the capability of a microgrid power system which could help them meet energy security objectives along with their net zero goals. There are also plans to explore the benefits of integrating energy storage systems with these future solar installations.

Through these efforts and the proposed energy efficiency and renewable energy technology projects as shown in the pie chart on this slide - FHL (an Army Reserve NZ Pilot installation) has concluded they can achieve Net Zero Energy by 2020.

If you look closely at the Pie chart which represents FHL's solution to Net Zero Energy – energy efficiency represents the largest percentage of what will bring them to Net Zero followed by solar photovoltaic, solar ventilation preheating, solar hot water, skylights, and ground source heat pumps. Additionally, due to the high cost of energy in California, becoming Net Zero Energy can save the installation approximately \$25 million over 25-years!

Next we will briefly cover a Net Zero water pilot - Camp Rilea.

**Slide 6:** Camp Rilea a Net Zero Water pilot is also a part of the Oregon Army National Guard – our one and only state-wide Net Zero Energy pilot.

Camp Rilea followed the Net Zero hierarchy to reduce their freshwater demand, they then offset that reduced demand with greywater reuse, and improved their water security.

They plan to further reduce their freshwater demand by implementing additional water efficiency and greywater reuse projects.

Now let's see how an integrated NZ pilot has followed the Net Zero Hierarchy in their approach to Net Zero Waste.

**Slide 7:** Fort Carson is taking the lead at striving towards net zero in all three areas – Net Zero energy, water and waste. Here are just a few of their Net Zero Waste initiatives, following the Net Zero hierarchy:

**REDUCE**

They have a proactive sustainable procurement program, and are actively working with their procurement officers to improve their purchasing practices

**REUSE:**

Fort Carson recently expanded their reuse efforts, in part due to a large Barracks Furnishing replacement project. They developed an MOU with the Defense Logistics Agency to develop a system to find companies and organizations that want used furniture. They recently reused about 50% of 600 wall lockers on-post (110 pounds/piece), and found a local company that was interested in taking the other 50%.

**RECYCLING and REUSE EFFORTS:**

All mattresses are sent to a local recycler (at no cost to Fort Carson) where the mattresses are dismantled. The metal spring is sold to a local scrap metal recycler. The quilt is shredded, compressed and baled. The remaining materials, foam, cotton are compressed and baled. Once 40k lbs. have accumulated, the bales are sent to a manufacturer for use as a raw material for such things as insulation and carpet.

They've established Recycling incentives for the military units on Post - \$100 for any unit that brings in 1,000 lbs.

Normally, QRP funds can't be used to pay for recycling of personal electronics, but the Fort Carson JAG signed-off on the use of a small amount of QRP labor for palletizing electronic waste in the interest of controlling hazardous waste. This allowed Fort Carson to establish an MOA with UNICOR to recycle their electronic waste.

Porcelain – yes toilets. There is a market interest in using porcelain for road base. Fort Carson collects the porcelain, and the City of Colorado Springs picks it up.

Fort Carson procured a new recycling truck with QRP funds that can weigh recycling containers as they are picked-up and emptied. This is a very important step in tracking data on recycling, and achieving higher recycling rates across the installation. Many Army installation Net Zero Waste initiatives are targeting weighing both recycling containers and solid waste dumpsters.

There is some minor composting taking place on the installation – time, local markets, and new technology will tell how successful they will be.

They have looked into Waste to Energy technology for one of the last approaches to Net Zero Waste – but economics just do not warrant this yet.

Now let's take a look at activities Army pilot installations have been busy with in their pursuit of Net Zero

**Slide 8:**

In the three plus years since the Army Net Zero Installation Pilot Initiative commenced, the Pilot installations and their Commands have accomplished a great deal.

- Energy audits at all of the Energy Pilots are complete, as are the water balance assessments at the Water Pilots.
- A material flow analyses at six of the eight Waste pilots are also complete.
- We developed a roadmap for one of the net zero waste pilots – Fort Polk

These audits, analyses, roadmaps, and water balances established a baseline for the installations. We then assessed the potential for future activities, by conducting renewable energy audits and, identifying water reuse opportunities and, waste re-use and diversion opportunities.

Later we will discuss Net Zero Actions and how to identify, develop, evaluate, validate and implement these potential opportunities to meet the installations' respective Net Zero area(s) by FY2020.

One thing we've learned is that Collaboration is a big part of the Net Zero Initiative. We've been hosting monthly calls for Energy, Water, and Waste and holding periodic progress review meetings. Participants have included: AMC, IMCOM, ARNG, USAR, MEDCOM, DeCA, DOE, and of course all of the pilot installations' key POCs. We're been documenting their challenges, success stories & best practices, so we can share them with all installations. This slide represents the activities the pilots have completed and been determine to be a best practice in how to get your Net Zero program off the ground and running.

Next I'd like to share a couple examples of what is sometimes called a 'roadmap' but really is the activities associated with developing a plan.

**Slide 9:** This example is from the Sierra AD road mapping or planning activity and shows the sequencing of projects through FY2020 to reach net zero. In planning Sierra AD's future we identified renewable energy technologies and potential project sites at the installation that will help the installation meet their Net Zero goal by FY2020. Each Roadmap developed for the pilot installations included a project list for FY13-FY20, with recommended:

- Energy efficiency improvements (e.g., bldg. envelope, HVAC equipment, lighting)
- Opportunities for waste heat recovery and combined heat and power (CHP), and



- Renewable energy projects (such as solar hot water, solar PV, geothermal, wind, or biomass)

As the roadmaps are implemented:

- The installation should see a steady reduction in energy consumption and
- A steady increase in renewable or alternative energy technologies

**Slide 10:** Here you can see the Net Zero Water roadmap developed for Fort Carson.

A Net Zero water roadmap builds a strategic framework from which the sites can implement initiatives to help drive them towards Net Zero. The roadmap, like that for energy, will contain specific projects, sequenced over several fiscal years, with the progress that each project will make toward Net Zero clearly identified.

Based on results from a water balance survey, Net Zero water projects are identified that will have the greatest effect on overall water demand reduction and will move the installation toward Net Zero.

Projects will include a mix of efficient technologies and projects that target alternate water sources that will replace the use of freshwater resources. There will be an emphasis on demand reduction and then alternate water projects. The installation's master planning activities will be part of the formulation of the roadmap so that the installation's current plans are well integrated into the Net Zero program.

**Slide 11:** Unlike energy and water, we chose a general roadmap for Net Zero Waste.

Here are the elements of a Net Zero Waste Roadmap:

The first component of the Roadmap is a Material Flow Analysis that looks at "outputs" (which is the current waste disposal) as well as "inputs" (like purchasing data). This links the volume of waste generated by activity with the source of that waste in the supply chain.

The installation's priority waste streams are also identified in the MFA.

The Roadmap develops strategies & specific projects for reducing or eliminating those waste streams, including:

- Improved purchasing practices
- Expanded re-purposing / re-use strategies
- Additional waste streams targeted for recycling or composting
- Potential energy recovery technologies

Then a strategy is formulated on the approach to take to implement these opportunities.

This brings us to the Army's four step approach to implementing Net Zero Initiate – Assess – Plan - and – Implement.

**Slide 12:** The information in this training module should be implemented from an installation-wide perspective. All aspects of installation operations must be included in Net Zero assessment and planning so that assessment activities take potential implementation considerations into account – the projects are the right scale to accommodate strategic needs, they are adaptable to possible changes in mission and participants, and they take into consideration other projects and management systems already deployed across the installation.

This Army's Net Zero Implementation Framework is organized into steps that reflect the overarching actions in Net Zero: Initiate Assess, Plan and Implement, as shown in this slide and the next.

This figure displays sections that reflect the overarching actions in Net Zero: Initiate Assess, Plan and Implement. These major steps are the framework to assist Army installations in striving toward Net Zero.

**Slide 13:** This table lists the major steps for the framework.

To provide a foundation for these iterative steps, linking energy, water, and waste data with installation activities can help identify opportunities for Net Zero actions and prioritize these actions more effectively than overall aggregated Net Zero data. A large proportion of installation activities are managed by a small number of organizations, such as the Directorate of Public Works, the Directorate of Logistics, and the military units. To date, Net Zero fell to a few implementing organizations, which creates the perception that Net Zero is the responsibility of these few organizations and lessens accountability to the end user or waste-generating activity. Since achieving Net Zero will require action by all stakeholders across the installation (military units, supporting organizations, tenants, contractors, suppliers, and families), identifying the responsible activity is necessary for success.

Organizing by activity establishes an installation-wide perspective for Net Zero assessment, planning and implementation which will reduce redundancies, improve effectiveness and increase efficiency. An activities-based approach also ensures that installation systems are addressed in their entirety, not piecemeal, and that the organizations with primary responsibility for certain activities (e.g., military operations and training) will have primary responsibility for all effects of the activities on energy, water, and waste.

**Slide 14:** Before implementing Net Zero activities, it is essential to define the stakeholders, goals and scope of the effort. To begin this process, it is important to build

consensus, set parameters, and define the scope. Stakeholder collaboration is crucial to successfully building this consensus and ensuring ownership of Net Zero goals. The installation Directorate of Public Works (DPW) may be the Office of Primary Responsibility (OPR) for Net Zero, but representatives from across the installation directorates need to be engaged in goal setting.

Achieving Net Zero requires action by numerous stakeholders across the installation; therefore, to successfully kick off Net Zero, the appropriate stakeholders must be identified and brought into the planning process.

Once these goals are delineated, the scope of the Net Zero actions should be established. For instance, an installation may choose to not include privatized housing/lodging or tenant organizations in defining and measuring progress towards their Net Zero strategy.

**Slide 15:** Achieving Net Zero requires action by numerous stakeholders across the installation; therefore, to successfully kick off Net Zero, the appropriate stakeholders must be identified and brought into the planning process. These are examples of several critical stakeholders:

- Garrison Commander
- Director of DPW
- Utility Planners and Operators (Government and/or privatized)
- Energy or Resource Managers
- Director of DPTMS
- Leads for Major Tenant Organizations
- Director of Resource and/or Budget Management
- Director of Contracting
- Defense Reutilization and Marketing Office
- Sustainability Officer

Initially, those having managerial responsibilities in the area of energy and water use and waste generation or disposal should be asked to participate in the planning process. As the effort expands, additional stakeholders may be added. These stakeholders will work together to set goals that meet installation-specific priorities.

**Slide 16:** There are many approaches to setting Net Zero goals. It is recommended this be done in a collaborative forum with representatives from each Directorate and each major planning process, in particular the installation's strategic and sustainability plans. Points of Contact for the installation's Environmental Management System should be involved, as should the Contracting Office Representative (COR) for the privatized utilities, as applicable. A workshop can be held that defines Net Zero, links it to existing plans and processes, and encourage attendees to set ambitious goals.

Goals should include specific timelines and shorter-term objectives along the way to the goals. Smart goals are specific, measureable, attainable, realistic, and time-bound.

**Slide 17:** Once the goals are delineated, the scope of the Net Zero actions should be established. For instance, an installation may choose to not include privatized housing/lodging or tenant organizations in defining and measuring progress towards their Net Zero strategy. As Army installations represent diverse geographic configurations, resource needs and availability, mission, and priorities it is critical for installation stakeholders to define the scope of Net Zero to support the installation's individual requirements.

**Slide 18:** Step 1 - Assess involves three major, interactive sub-steps, these steps are:

- Conduct Organization and Data Analysis
- Evaluate Current Resource Use
- Identify Opportunities and Needs

Installations need to understand what their resource usage actually is, which activities use these resources, and how they are used (or what waste is generated) in order to develop and target the most effective solutions. Much of this information is already available and used in planning and decision-making at the installation.

**Slide 19:** The first step in this process is to analyze the various sources, types, and fidelity of existing energy, water, and waste data. For example, the Army Energy and Water Reporting System (AEWRS), Solid Waste Army Reporting (SWARweb), energy audits, waste characterization studies, and water balances all provide data that may be useful in Net Zero planning. If existing data collection does not capture data at the user level, the installation may need to determine what major organizations exist and then to determine what major activities these organizations perform. These activities are then further analyzed to determine which are the major resource users and largest waste generators. Activities are correlated with resource use in order to identify the reduction/elimination strategies. Also important at this stage is to identify any priority resource use concerns. These are installation specific; for instance, if mission critical activities are dependent upon electricity and supply continuity is a concern (e.g. brown-outs); load-shifting activities may become a priority.

**Slide 20:** An important step in achieving Net Zero is to determine current installation resource use and requirements. This involves determining the inputs, generation, consumption and outputs of each resource. After correlating resource use with activity, the approach may vary based on which resource is being evaluated, but a common theme is balancing overall inputs and outputs to identify inefficiencies and unaccounted for losses in the system. This section reviews how to conduct this evaluation.

### Determine Resource Use

Inputs or consumption of water and energy can be determined using the existing Army Energy and Water Reporting System (AEWRS) data, utility records, and metering data, where available. These inputs represent current installation resource use.

### Correlate Resource Use with Activities

A successful Net Zero approach is based on linking energy and water use and waste generation with major activities at the installation. One way to organize Net Zero efforts along a common activity framework is to use Activity Groups based on Real Property Facility Category Codes and building numbers to associate buildings and facilities with different activities across the installation.

### Balance Inputs and Outputs

The final step in the current resource use evaluation is to balance the inputs and outputs. This step is done as a check to ensure that the current use estimate established is on target. Energy metering data should be reconciled with energy use estimates.

**Slide 21:** Results of the Net Zero resource use evaluation are integrated with additional input from stakeholders and existing reports, plans, and studies to conduct a Net Zero opportunities and needs analysis, as shown on this slide.

This sub-step serves to focus on additional opportunities that can be incorporated into existing plans and processes as well as be tracked as part the Net Zero effort. In order to successfully identify Net Zero opportunities within ongoing plans and processes, collaboration with the Offices of Primary Responsibility (OPRs) for each of these is essential. For instance, waste characterization studies conducted for Net Zero can identify new or expanded opportunities for waste minimization that can be rolled into the Pollution Prevention Plan, or new opportunities for waste diversion that can be rolled into the Solid Waste Management Plan.

### Identify Critical and Future Resource Needs

In order to achieve the Net Zero goals, future projections of resource consumption need to be estimated. To accomplish this, planned installation growth must be considered. Existing sources of databases and planning tools should be utilized to the maximum extent possible. Obtaining population growth data from the Army Stationing and Installation Plan (ASIP) is one potential source. The ASIP, which can be obtained at an installation's Plans, Analysis, and Integration Office (PAIO), is a powerful tool utilizing a seven year planning window capturing all projected force levels and other tenants on an installation. Other forecasting tools can be used to project future electrical and thermal consumption, water consumption and waste generation.

### Identify Opportunities

The end result of an Opportunities and Needs Analysis are potential Net Zero Actions, including all possible strategies that will move an installation toward its Net Zero goals. NZAs may be specific projects, changes in management approaches, education and awareness campaigns, new policies, improved metering and monitoring, or modified support contracts. Strategic priorities, along with the gaps between current performance and the Net Zero goals, are used to identify critical needs and opportunities. The Opportunities and Needs Analysis must not only include information about critical short-term needs, but must also help the installation managers understand and appreciate what the future challenges may be, and what they may need to start now if they hope to strive towards aggressive Net Zero goals and targets.

**Slide 22:** The Opportunities and Needs Analysis process should be integrated into existing installation-level plans and planning processes. This slide lists some resources that may already be available to an installation as starting points. Some installations have Sustainability Plans and/or Comprehensive Energy and Water Management Plans. Master Plans, Area Development Plans and Capital Investment Plans are also valuable inputs for requirements and needs identification. Energy Efficiency Audits and Renewable Energy Assessments can be performed to assist in identifying energy opportunities.

**Slide 23:** The Plan process guides the implementation of the Net Zero Actions. NZAs that emerge from the Plan process are integrated with other plans and processes at the installation; a separate plan is not produced. This can be done by ensuring OPRs from the other planning efforts are included in the Net Zero Plan process and have validated resulting NZAs. The Plan process brings installation organizations together in a collaborative process to develop and vet potential NZAs, evaluate feasibility, and prioritize such that a timeline is formed and a plan developed. The Net Zero Plan includes a timeline of NZAs with consideration to funding and execution issues and support of the responsible organizations.

The Plan step involves examination of the relationship between long-term strategic goals and current conditions. NZAs are identified during the Assess step that can bridge the gap between current conditions and the desired future; therefore Plans bridge the gap between high-level strategic plans (or Master Plans) and project planning. For Net Zero, the Plan process serves a critical role in scanning the range of opportunities, identifying those that are feasible, and then prioritizing the NZAs for action by an installation. This Net Zero step is therefore very compatible with other planning efforts. Plans can be created for individual Net Zero areas of energy, water and waste. Ideally, the Plan process includes NZAs from all three areas to avoid unintended consequences and leverage synergies. Multiple frameworks can be used to

organize the Plan as there are many attributes for each NZA that must be captured, such as impact on Net Zero, first cost, return on investment, and timeframe.

**Slide 24:** Develop Net Zero Actions. The first sub-step in the Plan process is applying a strategic perspective to further develop NZAs identified in the Opportunities and Needs Assessment step. Further refinement ensures that NZAs promote Net Zero goals while also supporting mission accomplishment. Aligning the NZAs with Activity Groups provides a consistent framework that applies to all Net Zero areas, links NZAs to offices of primary responsibility (OPRs) and maps NZAs to facilities. Data that is already available for the installation provides the starting point (e.g., previous planning efforts) in combination with any insights from Net Zero Step 1. NZAs may include infrastructure and technology-based recommendations as well as management-based efforts such as metering, data management, contracting mechanisms, partnerships, and awareness efforts.

Existing analysis, reports, and plans reveal a great deal about mission priorities and reasons why certain recommendations were (or were not) pursued in the past. Installations are likely to have Integrated Solid Waste Management Plans; Water Conservation Plans; Sustainability Goals, Plan or Teams; Capital Improvement Plans (that already include funding requests to upgrade and replace equipment and infrastructure); Vulnerability Assessments that identify critical infrastructure needs; or other studies regarding renewable energy potential, future water supplies, potential changes to recycling programs, energy conservation opportunities, and more. An example of another area of potential NZAs is energy and water security. It is recommended that energy and water security concerns be integrated with Net Zero to ensure the critical missions are supported by Net Zero activities.

**Slide 25:**

When developing a list of NZAs, many factors need to be considered and analyzed fully such as the ones noted on this slide. For example – does the purpose and implementation of an NZA align to the installations' mission? This should be the first and foremost consideration for any potential project reviewed.

Also – is the technology there? Is it proven? Or is it so new – private 3<sup>rd</sup> party financiers or other stakeholders might be reluctant to engage, especially if results of the life-cycle cost analyses of the potential NZA are less than solid.

Conduct your analysis on all variables of the NZAs as early in the process as possible. This will help build a strong case for your list of NZAs; gaining momentum with each hurdle crossed. And, and most importantly, the quicker a deal breaker is identified - the sooner you can move on to NZA's that have a better chance of being successfully implemented.

**Slide 26:** The second step to the Plan process is to prioritize the proposed NZAs, eventually creating a single, integrated schedule of NZAs which can then be integrated into other efforts. The evaluation criteria must be reviewed and agreed upon by the decision makers, but the Net Zero Hierarchy provides an important overall framework.

Priorities should also reflect the individual installation and its strategic needs. It is also important to recognize the impacts NZAs may have on each other – some will enhance other goals, while others may have negative impacts. The production of energy requires large volumes of water while the treatment and distribution of water is dependent on readily available, low-cost energy. The link between these two critical resources is not always crystal clear<sup>1</sup> – but there cannot be one without the other, so be aware of the emerging issues that may challenge efforts at pursuing one NZA or another **Negative impacts may include concentrating solar PV that while positively affects an installations Net Zero energy goals, this type of technology requires an amount of water that may impact Net Zero water goals, and a desalination plant requires energy which can impact Net Zero energy progress. Conversely, there are ways to leverage one for the other. Water projects do not usually carry a high rate of return and so combining water efficiency improvements with other energy savings projects can maximize the economic benefits<sup>2</sup>.** Decision criteria for use in the prioritization step should be developed in close coordination with stakeholders and may include those listed on the next slide or others that the installation identifies.

**Slide 27:** Multiple criteria are relevant for the NZA prioritization – this slide lists several suggested criteria. The evaluation criteria must be reviewed and agreed upon by the decision makers The Army's NZ policy dictates that NZ be implemented to the extent practical and fiscally prudent. Therefore it is critical to determine the feasibility of implementation and impact on resources use and costs.

**A key point is that we are journeying towards Net Zero. Success is measured, not by achieving Net Zero but getting as far along the journey as possible in a fiscally prudent manner.**

**Slide 28:** The next sub-step of the Plan process is validation. Validation of the draft list of NZAs and expected timeline is necessary to ensure that proposed solutions have both real potential for impact and are focused on issues that are critical to the installation and its mission. Collaboration here is essential, as in all Net Zero steps. A

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<sup>1</sup> Completing the Energy Sustainability Puzzle – The Energy ~ Water Nexus – A Strategy for Energy and Water Security, Sandia Laboratories, date unknown.

<sup>2</sup> Department of Defense FY13 Annual Energy Management Report, June 2014



stakeholder workshop is very effective for interaction amongst the various organizations on the installation, but other methods can be used. These engagement efforts are important because they not only help with planning, they also increase the validity of the Plan and increase the likelihood NZAs will be executed.

**Slide 29:** Don't forget to Document your results which will help facilitate integration into existing installation plans. Results of your efforts may take multiple forms and might even be as simple as a Microsoft® Excel spreadsheet, depending on the level of effort and number of Net Zero areas included. Common features include a list of NZAs, impact toward reaching Net Zero goals for each NZAs, cost of NZAs, and recommended timeline.

**Slide 30:** The Net Zero Pilot Installation Initiative allowed the Army to identify best practices and lessons learned that can be used to guide all installations in achieving their Net Zero goals. Capturing lessons learned and incorporating best practices in installation operations and management is a crucial step in institutionalizing Net Zero across the Army enterprise. Net Zero can decrease costs; improve energy and water security and increase operational capabilities and resiliency.

When we talk about Net Zero, it should be noted that the Zero in Net Zero is not necessarily absolute.

- Net zero is a management approach to strive towards Net Zero energy, water, and solid waste at Army installations where fiscally prudent.
- It is a holistic strategy that builds upon long-standing sustainable practices and incorporates emerging best practices in building and community to manage energy, water, and waste at Army installations.
- Net Zero contributes to the Army strategy for sustainability and energy security.
- Net Zero applies the principles of integrated design to ensure the Army appropriately manages its resources.
- The Army's concept for Net Zero recognizes that sustainable Army communities are more mission capable, resilient and compatible with local community needs.

Net Zero is not a stand-alone effort, but one that uses existing programs, plans and processes. Incorporating Net Zero into existing efforts is a common theme to all steps in this approach. Also fundamental to all Net Zero steps is enhanced collaboration. Installation directorates and personnel will need to collaborate to ensure all good ideas are investigated and acted upon. Installations will also need to collaborate with other installations, such that lessons learned are transferred. Collaboration with community and business partners is also essential, as are cooperative efforts with privatized utility and housing contractors.

All aspects of installation operations must be included in Net Zero assessment and planning so that Net Zero Actions (NZAs) take potential implementation considerations

into account – the projects are the right scale to accommodate strategic needs, they are adaptable to possible changes in mission and participants, and they take into consideration other projects and management systems already deployed across the installation.

**Slide 31:** A carefully developed and fully vetted Plan for implementation of NZAs will facilitate the coordination of the different levels of effort and the different stakeholders needed for implementation. Responsibilities for implementation of Net Zero actions and projects will fall in many functions and organizations across the installation. Some will require immediate action, and others will require carefully-planned longer-term actions. All implementation activities should start with engagement of the appropriate activity owners and organizations.

As each installation implements a Net Zero approach unique and tailored to its strategic priorities, a common element to all Net Zero approaches is quality resource use data based on major activities. Also critical is selection of NZAs that are vetted with the organizations responsible for the major activities. Linking resource use with NZAs helps track success. Initial Net Zero efforts may not be comprehensive or overarching, but an installation-wide perspective is needed to properly identify strategic priorities and engage needed stakeholders.

**Slide 32:** There are various recommended methods of implementing NZAs. Implementation of NZAs will vary depending upon the installation baseline conditions and strategic priorities, as defined in Steps 1 and 2. Net Zero implementation can take many forms at an installation. Therefore, categories of implementation were developed to assist installations in identifying a range of potential projects and actions, and to provide a framework for ongoing collaboration among the installations and with Army Headquarters and Commands. These are presented as categories and not steps, as there is no particular order in which these must be executed.

**Slide 33:** NZAs from all of these categories, as listed below, should make up the ongoing Net Zero implementation.

#### **Management Tools and Strategies**

Best Practices in terms of management tools and strategies involve applying integrated Net Zero concepts into existing processes such as master planning and installation management support contracts.

#### **Pilot Programs and Demonstrating New Technology**

Installations can conduct pilot programs and technology demonstration and validation (Dem/Val) projects to achieve Net Zero goals. The focus is on temporarily implementing a new approach or technology, to provide an opportunity to document the full effects of the Net Zero project before it is more permanently adopted. Installations have

successfully collaborated with their local communities to lead Net Zero and sustainability-focused partnerships and community organizations, and execute local or regional conferences on Net Zero and sustainability topics. These collaborations have opened communication channels, and have revealed many opportunities to collaborate on specific projects and initiatives, such as building renewable energy-based power plants and sharing services (e.g., recycling).

#### Outreach, Education and Awareness

Outreach, education and awareness efforts can be powerful approaches to achieving Net Zero. Awareness of Net Zero goals is critical so that members of the installation community will not only know that they need to handle and dispose of materials differently and make different choices about the energy and water they consume, but how to do that. Outreach, education and awareness are often low cost Net Zero best practices that may be overlooked, but these can often have significant impact or may be essential to support the success of other Net Zero efforts.

#### Existing Programs and Funds

Implementation of Net Zero best practices using existing programs and funds should be a priority, as this approach will enhance or add focus to programs already in place. Army installations have various opportunities for funding technology demonstration and validation projects, through programs such as the Environmental Security Technology Program (ESTCP). Potential research partners include the Environmental Protection Agency, the United States Army Corps of Engineers (USACE) Construction Engineering Research Laboratory (CERL), the National Defense Center for Energy and Environment (NDCEE), or any of the Department of Energy (DOE) National Labs. Installations will be most successful in accessing existing programs and funds when they can show that Net Zero projects can lead to efficiencies, cost savings, support mission impact, and use these positive outcomes to develop a bias for innovation and increased momentum for achieving Net Zero goals

**Slide 34:** Like all planning processes – an important step is after the plan has been implemented – documenting lessons learned and successes and ongoing monitoring activities. Installations need to share this information with other installations so they can reap the benefits of other's experience – without added expense.

**Slide 35:** The Net Zero management approach is based on four overarching actions: Initiate, Assess, Plan and Implement. As each installation implements a Net Zero approach unique and tailored to its strategic priorities, a common element to all Net Zero approaches is quality resource use data based on major activities. Also critical is selection of NZAs that are vetted with the organizations responsible for the major activities. Linking resource use with NZAs helps track success. Initial Net Zero efforts may not be comprehensive or overarching, but an installation-wide perspective is needed to properly identify strategic priorities and engage needed stakeholders.

**Slide 36:** Innovation will be key in making this happen. Innovation from installations, academia and private sector. The Army wants to leverage your experiences!

Thank you for tuning into Module 2 of the NZ online training – Net Zero as a Management Approach.

The next module will cover Net Zero Energy. Topics covered will include: Energy-specific summary of the NZ Energy Hierarchy; Energy efficiency/renewable energy drivers; Introduction to energy efficiency and renewable energy assessments; Introduction to cyber security requirements for Industrial Control Systems (ICS) and critical infrastructure, and energy and water security assessments. The module will also include discussion on Capturing alignment of current reporting and management requirements, successes, lessons learned and best practices for implementation.

Net Zero Water – Topics addressed will include: Water-specific summaries of the NZ Water Hierarchy; water sustainability/efficiency drivers; Introduction to water balance assessments; residential housing; potable and non-potable water options (purple pipe); and inter basin/ aquifer or climate constraints. The module will also include discussion on Capturing alignment of current reporting and management requirements, successes, lessons learned and best practices for implementation.

Net Zero Waste – topics addressed will include: Waste-specific summaries of the NZ Waste Hierarchy; sustainability/source reduction drivers; Introduction to waste characterization; Material Flow Analysis (MFA); Waste-to-Energy, and an overview of the Sustainable Products Center (SPC). The module will also include discussion on Capturing alignment of current reporting and management requirements, successes, lessons learned and best practices for implementation.

The remaining module will be an in-depth review Energy, Water, and Waste tools needed to achieve NZ. Additional information on Net Zero and other Army energy and sustainability programs and policies is available on our office website.

Thank you for your attention.

## **APPENDIX C**

### **Net Zero Training Module 3 Net Zero Energy**



Appendix C Net Zero  
Training Module



Appendix C NZ Energy  
Module 3 Speaker Not

## **Appendix C**

***Task 0818, "Army Net Zero Prove Out  
Final Net Zero Training Report***



# Army *Net Zero*

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## Army Net Zero Training Module 3: Net Zero Energy

Assistant Secretary of the Army  
(Installations, Energy &  
Environment)



# Module 3 – Net Zero Energy



- Target Audience and Learning Objectives
- The Driving Forces Behind Net Zero Energy
- Refresher
  - Army's Net Zero Pilot Installation Initiative
  - The Army's Net Zero Hierarchy
  - Net Zero as Defined in the Army Net Zero Directive
- What's Been Done
- Lessons Learned/Challenges/Best Practices
- The Army's Office of Energy Initiatives (OEI) and other Resources and Key Stakeholders
- Financing Net Zero Energy Projects
- Next Steps



# Learning Objectives



1. Review the Army definition of Net Zero Energy and the driving forces building Net Zero Energy in the Army
2. Explore techniques Army Net Zero Energy Pilot Installations are using to implement Net Zero Energy by investigating examples of their activities and contributions to the Army's future success in Net Zero efforts
3. Review the basics of funding and contract mechanisms available for implementing energy projects at your installation





# Federal Mandates



Federal Mandate	Focus Area	Performance Target
Energy Policy Act of 2005	Electricity use from renewable sources	At least 5% of total electricity consumption (FY10-12), 7.5% (FY13 +)
Executive Order 13423	Energy use in Federal buildings	Reduce 3% per year to total by 30% by FY2015 (FY2003 baseline)
	Total consumption from renewable sources	At least 50% of required annual renewable energy consumed from "new" renewable sources
	Fleet vehicle alternative fuel use	Increase by 10% annually to reach 100% (FY2005 baseline)
Energy Independence & Security Act of 2007	Total consumption from renewable sources	25% by FY2025 - "Sense of Congress"
	Hot water in new / renovated federal buildings from solar power	30% by FY2015 if life-cycle cost-effective
	Fossil fuel use in new / renovated Federal buildings	Reduce 55% by FY2010; 100% by FY2030
Executive Order 13514	GHG emission reduction	<ul style="list-style-type: none"> <li>DoD Goal: reduce Scope 1 &amp; 2 GHGs by 34% by FY2020</li> <li>DoD Goal: reduce Scope 3 GHGs by 13.5% by FY2020</li> </ul>
	Net zero buildings	All new buildings that enter design in FY2020 & after achieve net zero energy by FY2030
	Water consumption	Reduce consumption by 2% annually for 26% total by FY2020 (FY2007 baseline)
	Waste minimization	Divert at least 50% of solid waste & 50% of C&D waste by FY2015
National Defense Authorization Act, 2010	Renewable fuels use	Directs the Secretary of Defense to consider renewable fuels in aviation, maritime, and ground transportation fleets.
	Facility renewable energy use	Produce or procure 25 % of the total quantity of facility energy needs, including thermal energy, from renewable sources starting in FY2025

# What the Army Reported in FY13



Focus Area	Federal Mandate	Performance Target	Goal	Army Reported in FY13	Did the Army Meet Goal in FY13
Electricity use from renewable sources	Energy Policy Act of 2005	RE consumption (annually) equals 7.5% of total Electrical consumption	7.5% annually	1.1%	No
Reduce Facility Energy Intensity	EISA 2007	Reduce Facility Energy Intensity (Btu of energy consumed per gross sq ft.)	-24.0%	-14.2%	No
Facility renewable energy use	2911e	RE produced or procured equals 25% of total facility energy needs, (including thermal)	15% by FY18 and 25% by FY25	7.10%	NA - but must double to reach target of 15% in 4 years

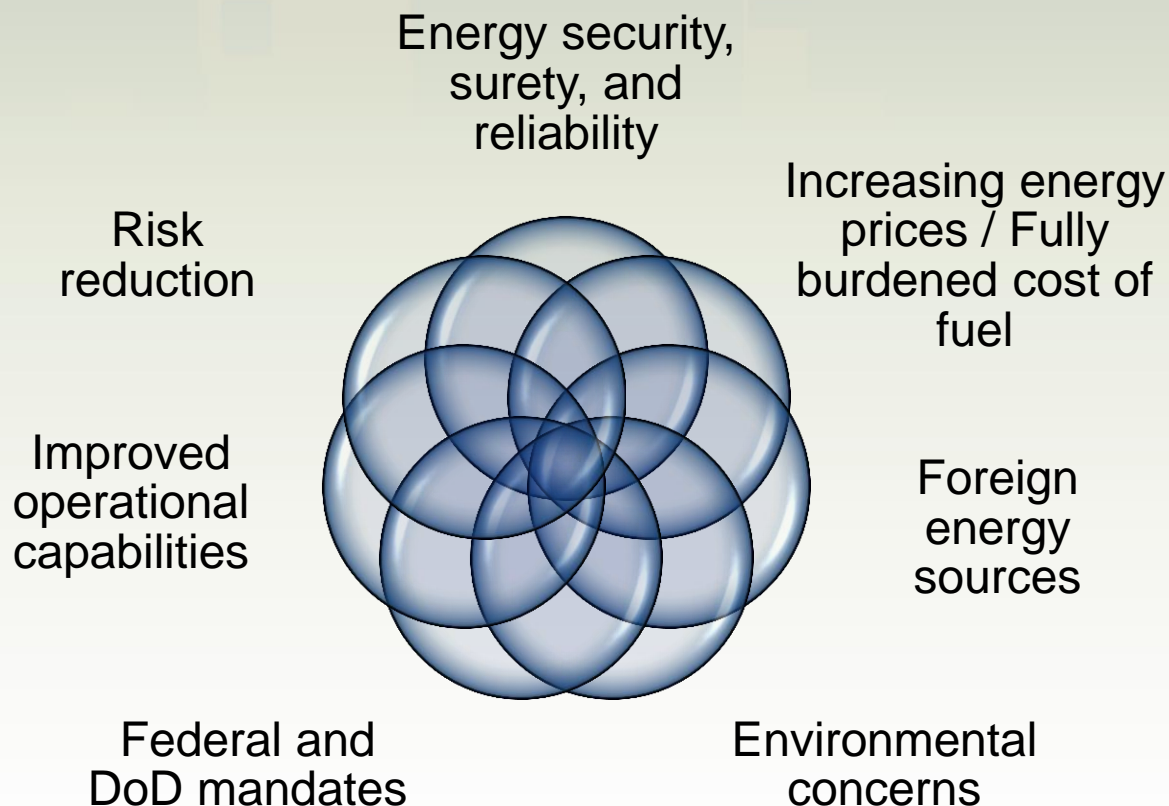
## Army's Progress since FY06

	FY06	FY07	FY08	FY09	FY10	FY11	FY12	FY13	FY14	FY15
Army	-5.00%	-8.40%	-7.20%	-7.20%	-8.70%	-11.80%	-15.70%	-14.20%		
EISA Goal	-3%	-6%	-9%	-12%	-15%	-18%	-21%	-24%	-27%	-30%

Army Energy Intensities FY03 (Baseline Year) and FY08 to FY13 - Intensity reported in Btu/GSF						
FY03	FY08	FY09	FY10	FY11	FY12	FY13
97,248	89,802	93,051	91,499	85,739	82,002	83,432



# Drivers of Change



**Resulted in Creation of Net Zero Programs for  
Energy, Water, and Waste**

## Energy Pilot Installations

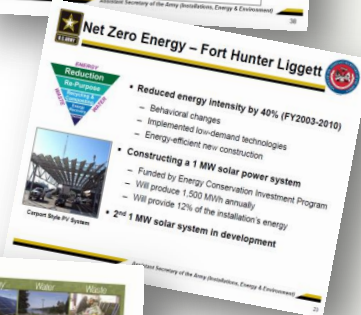
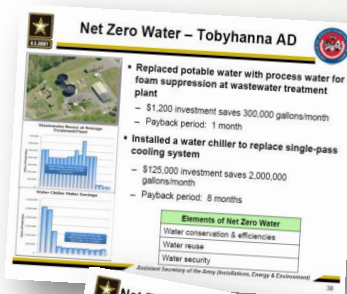


# Internal and External Collaboration

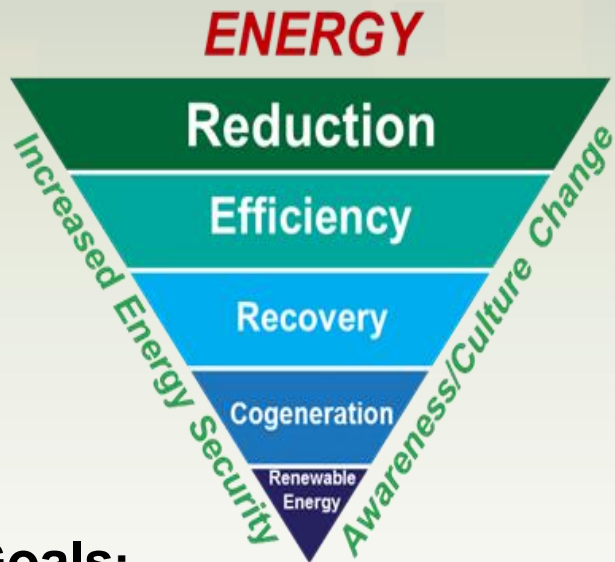


- Share and document lessons learned
- Build cross-functional Net Zero teams
- Assist each other with challenges
- Conduct monthly calls and periodic progress meetings

- Local and regional authorities
- Federal Government
- Public-private partnerships



# Net Zero Energy Hierarchy



Net Zero ENERGY: reducing overall energy use, maximizing efficiency, implementing energy recovery and cogeneration opportunities, and offsetting the remaining demand with the production of renewable energy from onsite sources, so that the Net Zero energy installation produces as much renewable energy as it uses over the course of a year.

## Goals:

- Enhance mission effectiveness
- Contribute to energy security
- Increase energy efficiency and conservation
- Preference for use of renewable energy for on-site power; enables continued operation if grid goes down
- Ensure redundant energy supply sources
- Culture change is needed
- Fiscal responsibility





# Getting Started

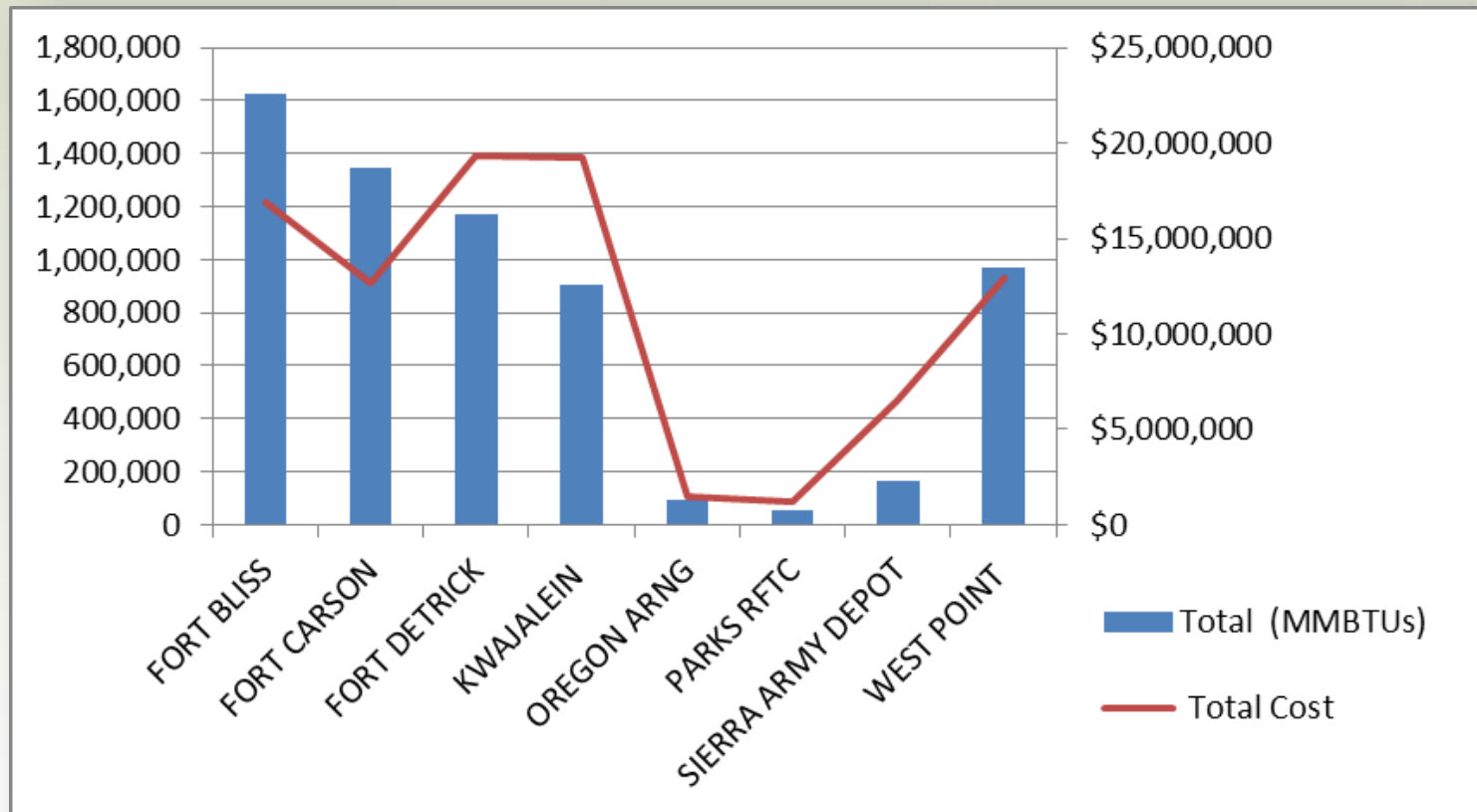
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- Energy Baseline
- Energy Efficiency Assessments
- Renewable Energy Assessments
- Energy Security Assessments
- Strategizing a Plan (also known as road mapping)
- Project Implementation



# Installation Baseline (FY10) Energy Consumption



- Significant potential: 6.4 T BTU and \$92 M
- ~8% of Total Army Facility Energy Consumption



# Energy Efficiency Assessments



## Audit Statistics

- Audited 350 buildings
- Audits covered over 11.6 M sq. ft.
- Found 345 MMBTU of energy savings per year
- Savings totaled over \$15.5 M per year

Used Energy Models  
To Project Potential  
Savings Across  
Entire Installations

Energy Efficiency Is a  
Moving Target And More  
Savings Can Be Achieved

## Example Energy Conservation Measures (ECMs)

- ☐ Building envelope ECMs: improved wall/roof insulation, replacement of un-insulated windows and doors, and general weatherization
- ☐ Control ECMs: programmable thermostats, occupancy sensors, exhaust fan/water cooler timers, building controls upgrade
- ☐ Lighting ECMs: retrofit or replacements of existing lamps and ballasts with higher efficiency/low wattage alternatives
- ☐ Mechanical ECMs: retro/continuous commissioning; high-efficiency boilers, chillers, pumps, fan motors, and water heaters

# Renewable Energy Assessments



## ■ Process

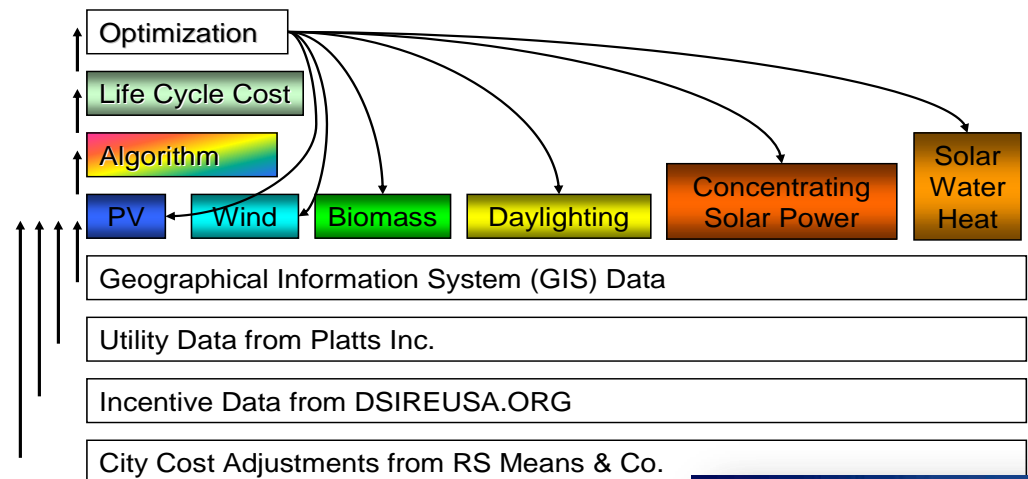
- ❑ Start with screening tools
- ❑ Conduct further analysis of promising technologies
- ❑ Make recommendations

## ■ Analysis tools

- ❑ GIS resource screening tools
- ❑ Renewable Energy Optimization (REO), PV Watts, In My Backyard (IMBY), RET Screen, Solar Analysis Model (SAM)

## Renewable Energy Optimization (REO)

- REO finds the least-cost combination of renewable energy technologies to meet net zero goal



## Considerations

Think outside the “standard tool” box → fuel cells, micro turbines, solar pools, etc.



# Renewable Resource Assessment



	Solar PV	Wind	SHW	SVP	GSHP	Biomass WTE	Geo-thermal
Camp Parks	X		X	X	X		
Ft. Bliss	X		X	X	X	X	X
Ft. Carson	X	X	X	X	X	X	
Ft. Detrick	X		X	X		X	
Ft. Hunter Liggett	X		X	X	X		
Kwajalein	X	X	X				
Oregon NG		X		X	X	X	
Sierra AD	X		X	X	X		X
West Point	X		X	X		X	



Wind



Biomass



Geothermal



Solar

- Solutions are based on resource availability and economics
- Strategies must evolve as technology, markets, incentives, and economics change (e.g. PV prices dropping~50% over the last few years)



# Energy Security Assessments



## Goals:

- Identify energy security concerns and address mitigation solutions
- Integrate energy system infrastructure upgrades
- Align infrastructure issues with Renewable Energy (RE) and Energy Efficiency (EE) recommendations
- Develop a comprehensive Energy Security Assessment, aligned with the Installation Master Plan

## Uncovers many items that are critical to the correct functionality of NZE projects planned or underway

- ☐ Are the existing distribution system components capable of handling an additional megawatts (MWs) of RE?
- ☐ Can power flow be bi-directional?
- ☐ Can my design be microgrid ready?
- ☐ Has energy storage been considered?
- ☐ Am I building specifications that meet my long-term Energy Master Planning needs?



# Energy Security Action Plan (ESAP)



The ESAP and Conceptual Methodology for Fort Hunter Liggett consisted of these eight steps:

- 1) Determine the energy security baseline metrics.
- 2) Conduct an Unclassified high-level Energy Security Assessment (ESA) which incorporates the baseline metrics.
- 3) Conduct a high-level electrical distribution system upgrade assessment.
- 4) Determine actions required to conduct a high-level conceptual design of a Microgrid to address energy security concerns.
- 5) Align with energy efficiency recommendations.
- 6) Align with renewable energy recommendations.
- 7) Determine additional metrics not presently identified, but valuable to quantifying energy security values in the future.
- 8) Deliver assessment results/NZE-ESAP to site leadership.

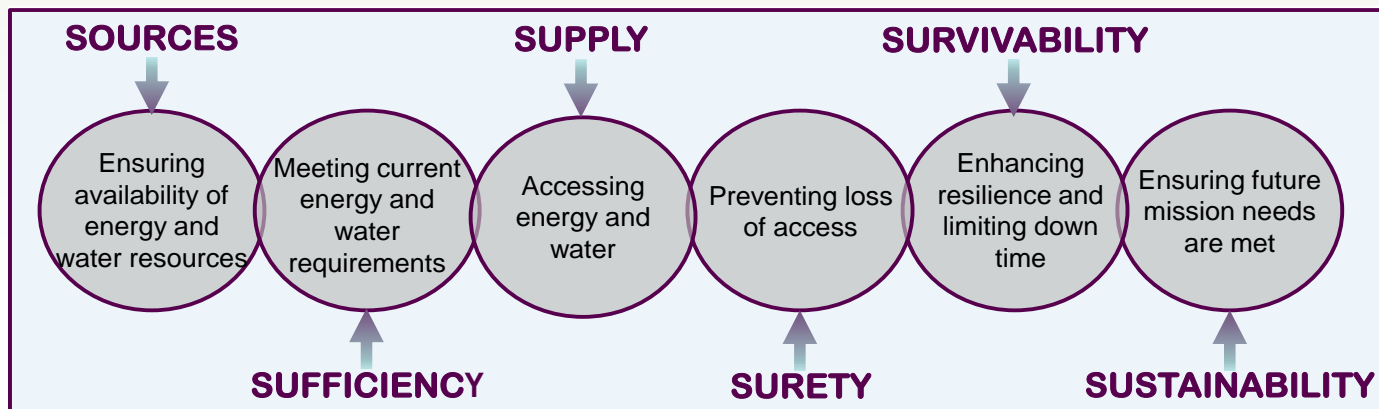


# Energy and Water Security Assessment



The Fort Bliss Net Zero EWSA Protocol includes these steps:

- 1) Data call to the installation for any existing information,
- 2) Pre-coordination,
- 3) Onsite data collection,
- 4) Data analysis, risk assessment, and mitigation action development;
- 5) Validation of results and proposed mitigation measures; and,
- 6) Final outbrief to the Garrison leadership.



**Merged Energy and Water Security Definitions Resulted in these Security Indicators**

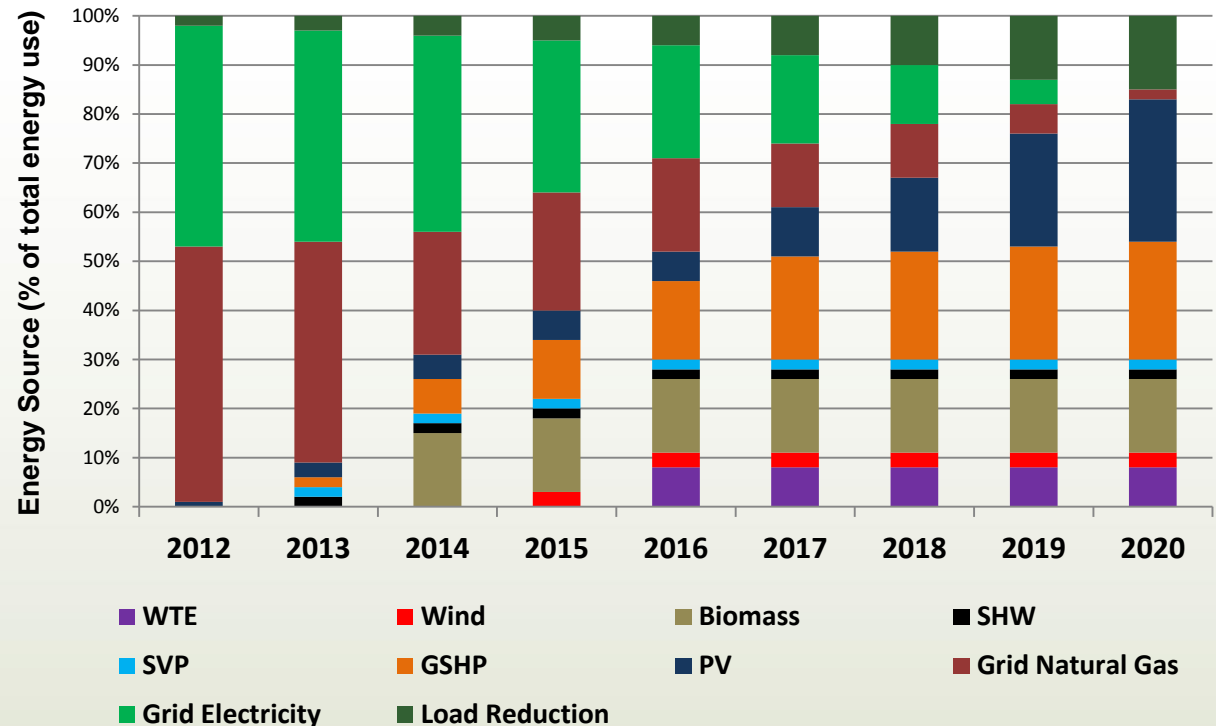


# Building the Net Zero Roadmap



## Implementation Plan to Achieve Near Net Zero Energy by 2020

- Energy Baseline
- Behavior Change
- Energy Efficiency
- Renewable Energy
- Energy Security
- Master Planning
- Economics



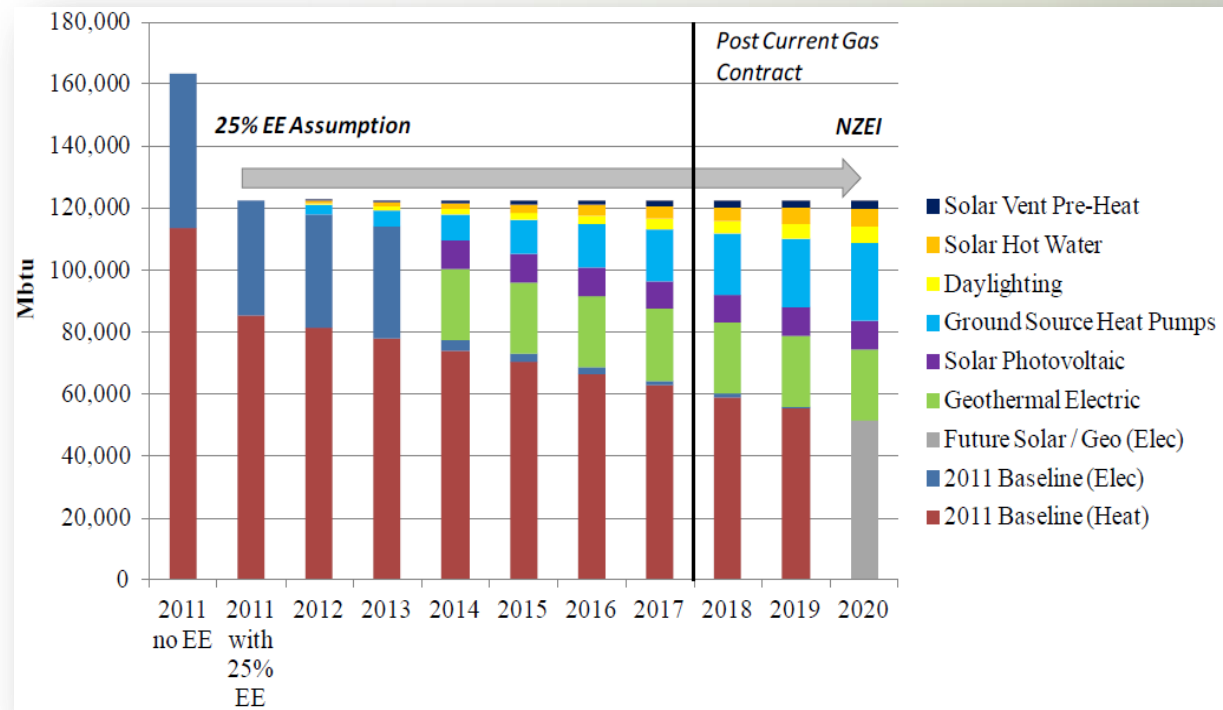
Align Energy Project List and Implementation  
Recommendations to best meet the 2020 NZE goal

# Energy Roadmap (Plan)



## Sierra Army Depot Load Reduction and Renewable Energy Integration Roadmap

If you follow  
along the graph  
you can see how  
as RE projects  
are implemented  
energy  
consumption is  
reduced



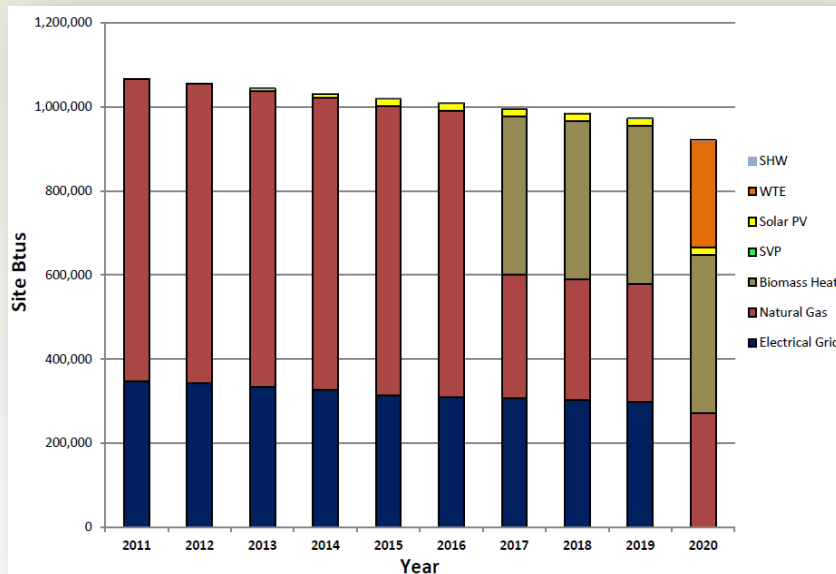
From NREL's *Targeting Net Zero Energy at Sierra Army Depot, California: Assessment and Recommendations*



# Energy Roadmaps (Plans)

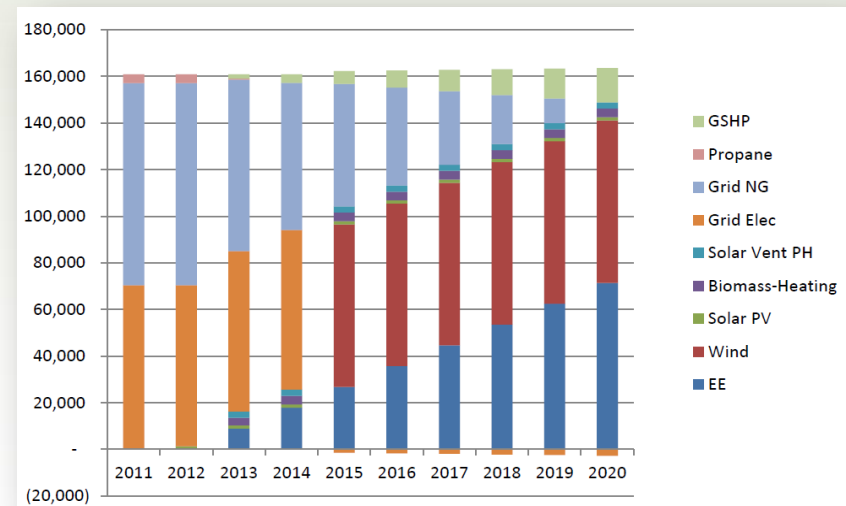


## West Point Net Zero Energy Strategy



From NREL's *Targeting Net Zero Energy at US Military Academy West Point: Assessment and Recommendations*

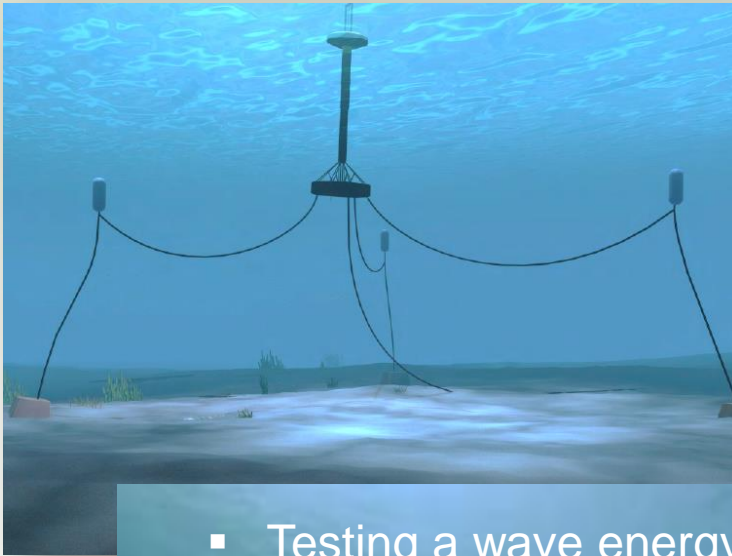
## Oregon Army National Guard Load Reduction & Renewable Energy Integration Roadmap



From NREL's *Targeting Net Zero Energy at Oregon Army National Guard: Assessment and Recommendations*



# A Stellar Example – Oregon ARNG



- Testing a wave energy converter
- Harnesses the pressure of a wave on the ocean floor



**Biomass  
Pellet Boiler**



**Camp Withycombe  
Industrial Lighting**



# Best Practices – Energy



- **Conduct thermal building envelope analysis**
  - ❑ IR thermography identifies heat loss & enables targeted repairs
- **Reduce energy use through energy management control systems (EMCS)**
  - ❑ Provides ability to control energy-consuming devices (e.g., fans, compressors, boilers, chillers, pumps, lights)
- **Hire resource efficiency managers (REMs)**
  - ❑ REM's goal is to reduce consumption & cost of energy
  - ❑ Work with existing staff to enhance conservation efforts

# Best Practices – Energy (cont.)

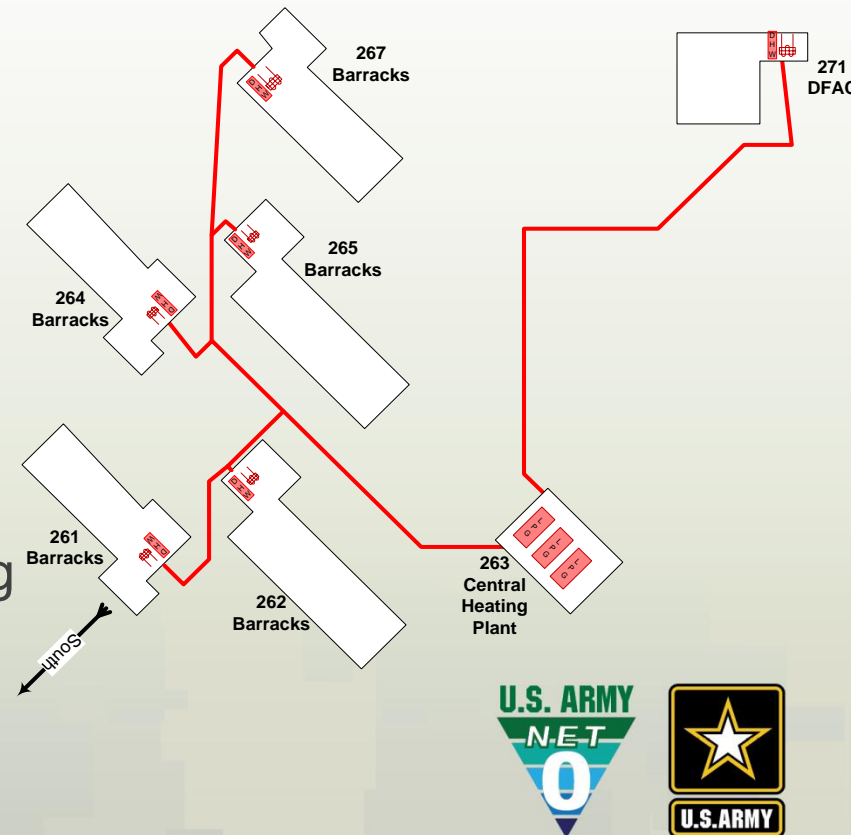


- **Pursue alternative financing mechanisms**

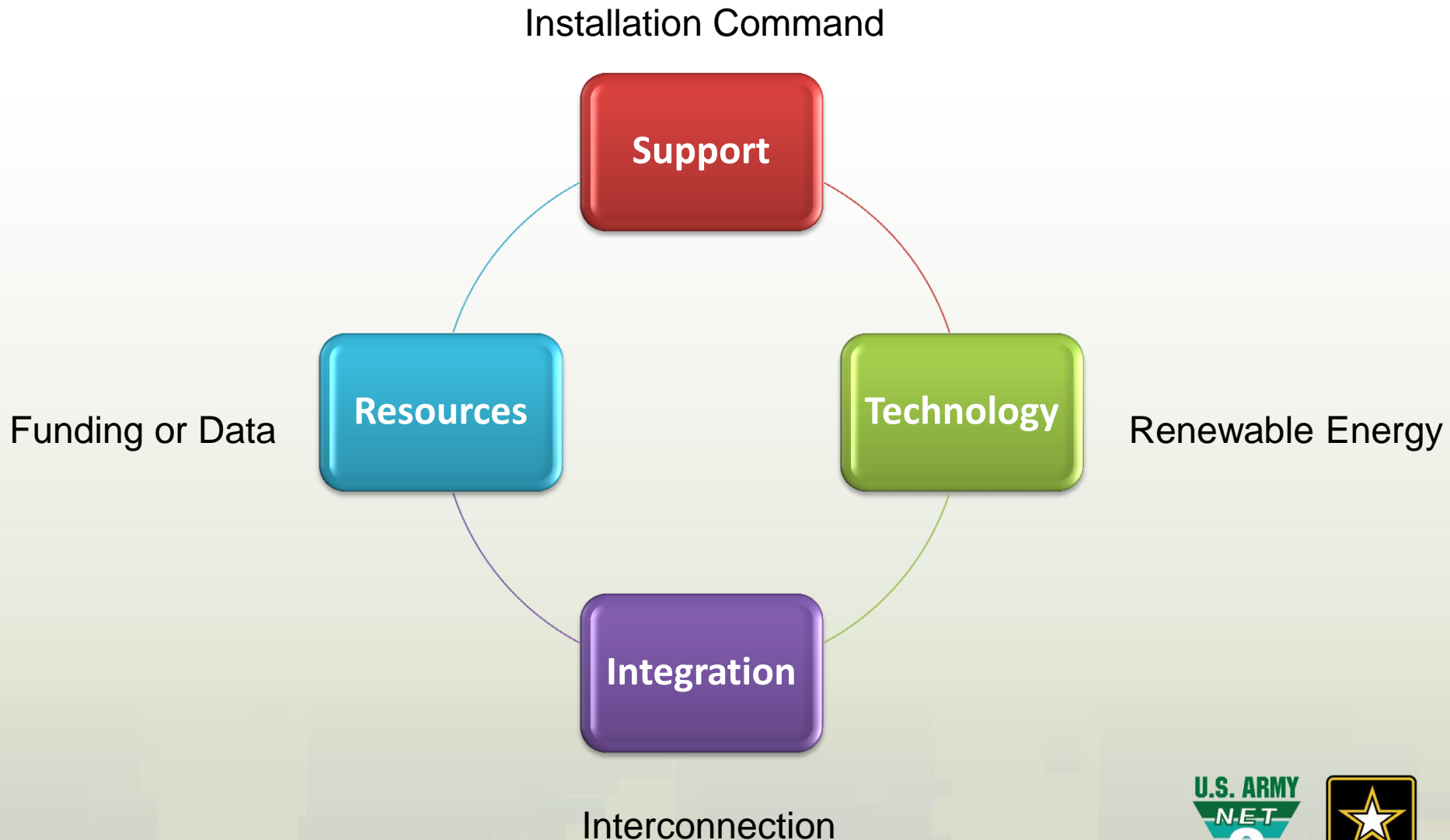
- ☐ Energy Savings Performance Contracts (ESPCs)
- ☐ Utility Energy Service Contracts (UESCs)

- **Conduct energy master planning**

- ☐ Integrates energy efficiency & renewable energy goals & planning into the Real Property Master Plan
- ☐ Enables renewable energy options that aren't feasible at a single building (e.g., central utility plants to serve a Brigade complex)



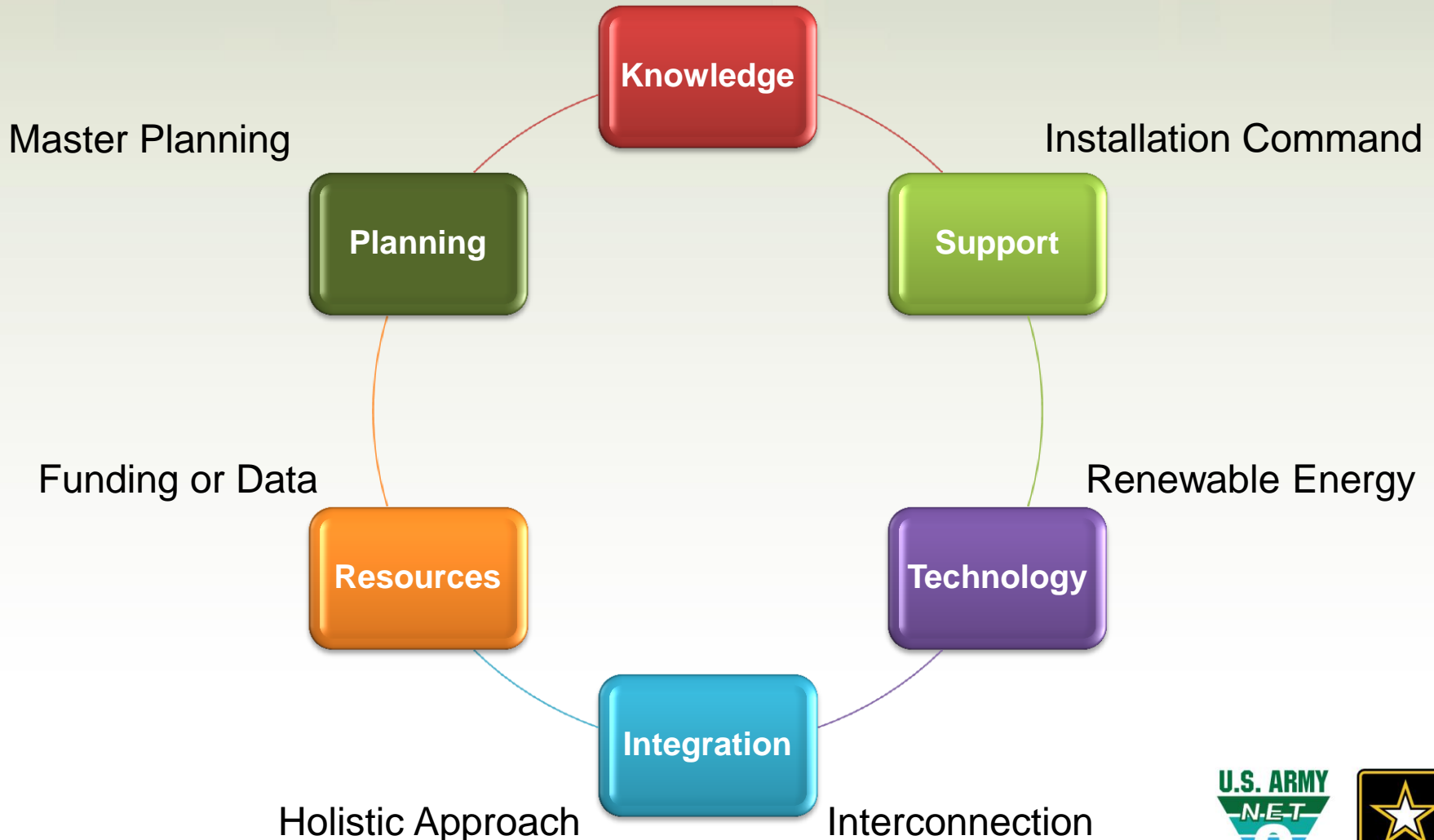
# Lessons Learned at the Onset of NZ



# ...as the NZ Initiative Progressed



The Energy Team



Holistic Approach

Interconnection



# Proposed Net Zero Solution Summary



Installation	EE Estimate	% Thermal RE	% Electrical RE	% Total Energy from RE
Camp Parks	31%	86%	100%	96%
Ft. Bliss	15%	46%	100%	78%
Ft. Carson	17%	93%	100%	96%
Ft. Detrick	20%	45%	71%	76%
Ft. Hunter Liggett	38%	100%	100%	100%
Kwajalein	25%	NA (all electric)	83%	83%
Oregon NG	47%	100%	100%	100%
Sierra AD	25%	100%	100%	100%
West Point	22%	50%	100%	77%

***The Army recognizes the challenges in achieving total Net Zero due to the likelihood that it may not be cost effective. A key point is that we are journeying towards Net Zero.***



# Project Implementation Funding Strategies

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- Military Construction (MILCON)
- Sustainment, Restoration and Modernization (SRM)
- Alternative contract and funding mechanisms available to Army Installations through congressional authorizations
  - ☐ Energy Savings Performance Contract (ESPC)
  - ☐ Utility Energy Service Contracts (UESC)
  - ☐ Enhanced Use Lease (EUL)
  - ☐ Power Purchase Agreement (PPA)

Additional information can be found on the FEMP Financing Mechanisms website:

[www.femp.energy.gov/financing/mechanisms.html](http://www.femp.energy.gov/financing/mechanisms.html)







## ESPC:

- Statutory authority 42 USC 8287 and 10 USC 2913
- Contractor engaged in energy related improvements.
- Payment accomplished from the savings achieved.
- Savings guaranteed by the Contractor
- Contract term 25 years

## UESC:

- Statutory authority 10 USC 2913
- Existing Utility engaged in energy related improvements
- Compensated from projected savings over the contract period
- Savings are not guaranteed by the Utility
- Requires a 10 years or less payback.



# Power Purchase Agreement (PPA)

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- Utility constructs or develops, owns, operates, and sells the energy output
- Provides tax credits the Army is not eligible for
- No specific statutory acquisition authority enacted for the PPA approach.
- Assumed that the energy purchased will be produced from a privately owned and operated energy facility or project located on or off of federal land.



# Enhanced Use Lease (EUL)



## What is Enhanced Use Leasing?

- Tool to more effectively use underused property to benefit installations.
- Leverage DoD assets
- Receive rent in cash or in-kind services no-less-than FMV of asset.

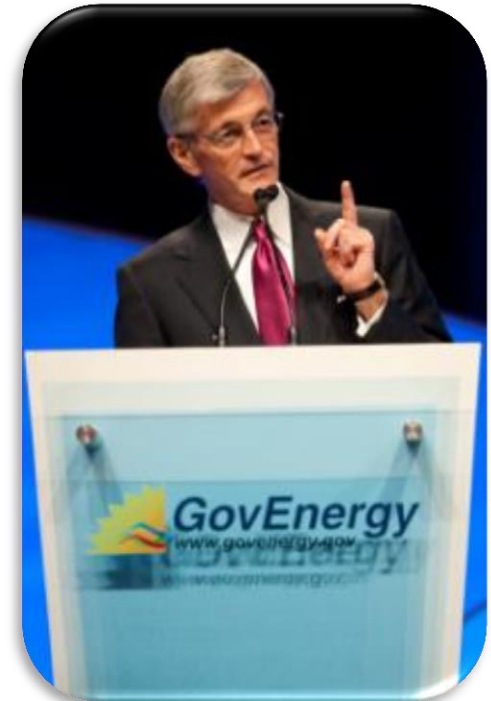
EUL provides private sector expertise and financing for the development of energy projects on Army lands. It potentially provides on-site energy sources for an Army installation to meet Army energy security and renewable energy program requirements. It can be used for any scale of energy project.

# Army Office of Energy Initiatives



Established by the Secretary of the Army on September 15, 2011. The Energy Initiatives Task Force (EITF) (as it was originally called) serves as the central management office for **partnering** with Army installations to implement **cost-effective, large-scale**, renewable energy projects, leveraging **private sector financing**.

- Projects **equal to or greater than 10MW**
  - ❑ Will coordinate with installations for 1-10MW opportunities
  - ❑ Potential for projects that exceed Army requirements
- Solar, Wind, Biomass and Geothermal technologies
- Resources to perform project development and execution
- Will use existing DoD land-use and third-party financing authorities



Secretary of the Army  
John M. McHugh

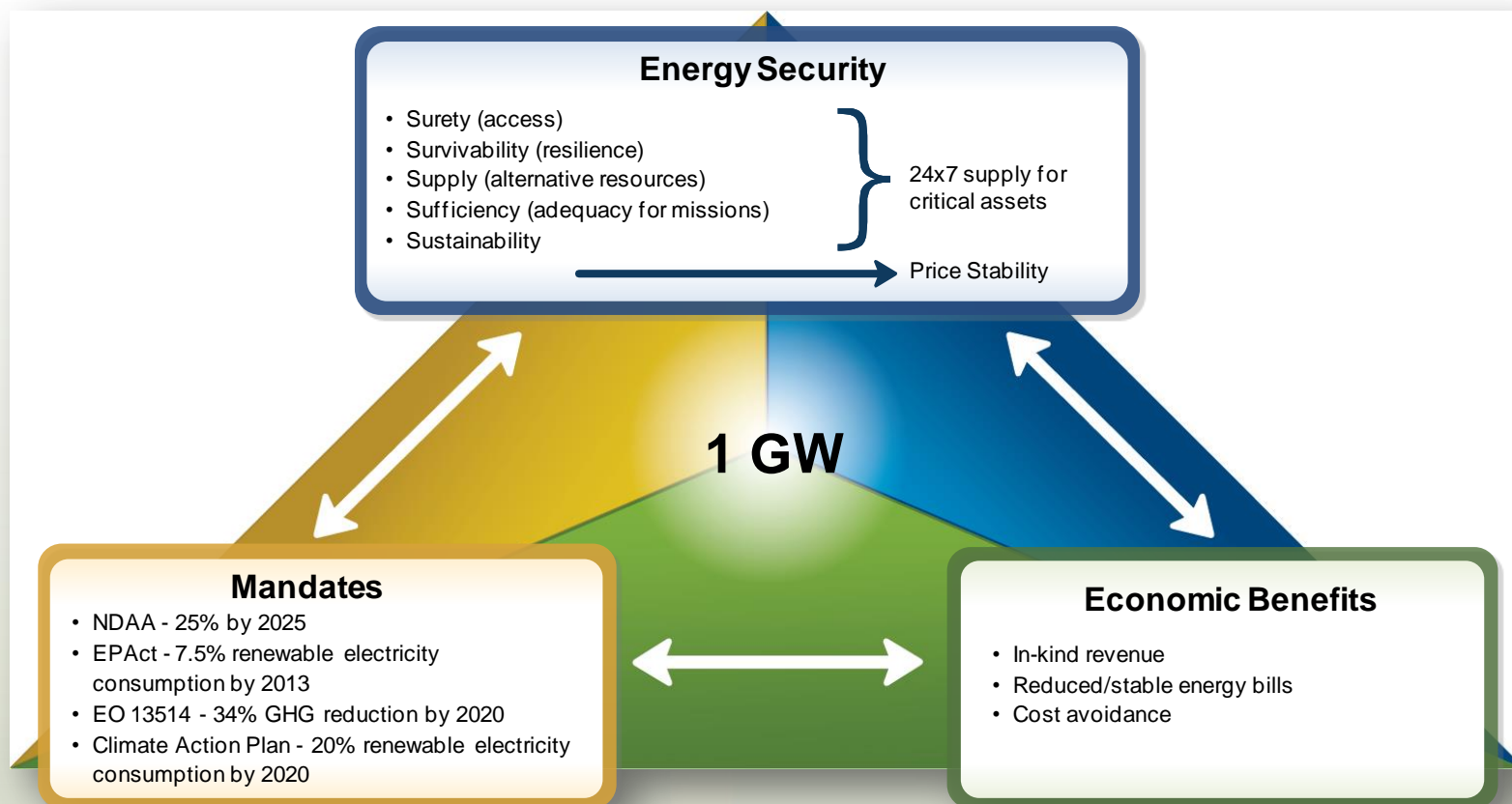


*The OEI's projects will help ensure the Army's goal to deploy  
1 GW of renewable energy projects by 2025*

# The Army's Office of Energy Initiatives



The Army's Office of Energy Initiatives (OEI) seeks to create a balanced pipeline of opportunities that will serve three driving principles



# OEI Project Evaluation Criteria



**8 Assessment Criteria should be reviewed regularly to identify and mitigate excessive risks and key issues for successful project development.**

<b>Mission/Energy Security</b>	<ul style="list-style-type: none"> <li>• How does project enhance energy security on host and surrounding installations?</li> <li>• What are the possible impacts to Installation operations or tenant missions?</li> <li>• Has the project been approved by Installation, Army HQ, and DoD staffs?</li> </ul>
<b>Economics</b>	<ul style="list-style-type: none"> <li>• What is the estimate of the baseline capital cost?</li> <li>• What is the value of any RECs or other incentives?</li> <li>• What is the predicted resource? Has it been validated?</li> <li>• What is existing utility rate and alternative tariffs?</li> <li>• What are the impacts of the project to the POM?</li> </ul>
<b>Real Estate</b>	<ul style="list-style-type: none"> <li>• What is the Real Estate approach and what authority is being used?</li> <li>• Identify and mitigate real estate siting, constructability, access, or land use issues.</li> <li>• Is the project consistent with the Installation Master Plan?</li> </ul>
<b>Regulatory and Legal</b>	<ul style="list-style-type: none"> <li>• What are the regulatory limits for interconnection, net-metering?</li> <li>• What is the status of getting required PUC approvals?</li> </ul>
<b>Market/Off-Take</b>	<ul style="list-style-type: none"> <li>• Will the installation consume all electricity generated?</li> <li>• What is the status of state RPS and other incentives to drive external demand?</li> <li>• If power is to be sold off the installation, have off-takers been identified?</li> <li>• Can the utility wheel power to other potential off-takers?</li> </ul>
<b>Technical/Integration</b>	<ul style="list-style-type: none"> <li>• Is there sufficient line and substation capacity? What upgrades are required?</li> <li>• Are flow studies are required? What is the status?</li> <li>• Is the system upgradeable for smart grid and energy storage technologies?</li> </ul>
<b>Environmental</b>	<ul style="list-style-type: none"> <li>• What are the major environmental issues?</li> <li>• During the project lifecycle, which parties will perform ECP and NEPA requirements, and when?</li> </ul>
<b>Procurement</b>	<ul style="list-style-type: none"> <li>• What is acquisition strategy and timeline to implement?</li> <li>• What performance risks are there with the developer or other partners?</li> </ul>

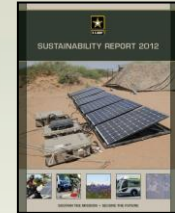


# Questions?



## Army Sustainability Report 2012

<http://usarmy.vo.llnwd.net/e2/c/downloads/269536.pdf>



## Office of the Assistant Secretary of the Army for Installations, Energy and Environment

<http://www.army.mil/asaiee>



## Office of the Deputy Assistant Secretary of the Army, Energy and Sustainability

<http://www.asaie.army.mil/Public/ES/>

## Army Net Zero

<http://www.asaie.army.mil/Public/ES/netzero/index.html>



Slide 1: Hello - I am Kristine Kingery. I work in the Army Secretariat in the Office of the Assistant Secretary of the Army for Installations, Energy and Environment. I am the Director of Army Sustainability Policy and the Army lead for the Net Zero Installation Initiative. Thank you for tuning in to Session 3 of the Net Zero online training: Net Zero Energy

Slide 2: This is Module #3 - Net Zero Energy - and like the previous two modules I will start with a list of topics to be covered, beginning with the target audience and learning objectives.

I'll go over the Federal, DoD and Army regulations that have shaped Net Zero Energy – the goals and the reporting requirements mandated from those regulations and how the Army now defines Net Zero Energy.

The Army's Net Zero Pilot Installation Initiative, the Net Zero Hierarchy and the final defining goals of Army Net Zero energy, water and waste were discussed at length in the previous modules – but a brief refresher is appropriate here.

If you are a seasoned Energy Program Manager at an Army installation – you probably are already well aware of all contracting and funding mechanisms available to the Army - but I encourage you to follow along with this part.

I'll talk about what's been done so far under the Net Zero Pilot Initiative – how Net Zero energy baselines were determined, and all of the assessments and audits conducted on the pilot installations. I'll showcase a couple of 'stellar examples' and cover what's worked for some installations (best practices) and how to overcome those challenges that Army installations may still be facing (lessons learned) and who's working together to help resolve those and emerging issues.

We'll end with what's next for Next Zero and provide contact information for any questions not answered during the course of this training.

Slide 3: As I mentioned before in the first module - although everyone is welcome to learn about the Army's Net Zero Initiative - the target audience for this training is Directorate of Public Works staff – particularly their Energy Program Manager but also Master Planners and other applicable garrison staff such as the Installation Sustainability Officer.

The main objective of this training is to provide you with a basic understanding of Net Zero Energy– what it is – what it means to you as someone who works on an Army installation and how to implement Net Zero at your installation. Specifically this module will detail what other Army installations are doing and lessons learned from their efforts.



This information will enable you to explore possible approaches that may work at your installation as you journey towards Net Zero Energy.

Through three plus years of providing support to, working with, and gleaning knowledge from the eight (8) Army NZ Energy pilot installations and one (1) statewide Army National Guard location, the Army has a better understanding of what installations need to do to journey towards NZ Energy. This knowledge will be shared in the form of best practices and lessons learned as presented throughout the course of this module. We will cover the Energy Efficiency Assessments, Renewable Energy Assessments, the NZ Energy Security Action Plan, the Integrated Energy and Water Security Assessment, the Energy 'Roadmaps' or what we now call 'Plans' for 3 of the pilots and a general roadmap or plan, and a NZ Solution Summary for the Pilots.

While this training cannot possibly instruct on how to conduct all of these – it will give an installation energy program manager an idea of what's involved in these assessments, help determine if their installation needs one and how to pursue the required resources to accomplish these assessments.

Ok let's move on to the next slide where I will pause for a moment to give you a chance to review the mandates and reporting requirements driving Net Zero Energy.

Slide 4: As energy or sustainability professional working on an Army installation the federal mandates listed in the chart on this slide are nothing new. (PAUSE)

One performance target, from EO13514, I would like to bring to your attention is the requirement for all new buildings that enter design in 2020 and after to achieve Net Zero Energy by 2030. This target is one of the drivers for the Army's pursuit of Net Zero Energy, Water, and Waste. (PAUSE)

Do you know whether or not your installation has met or will meet the prescribed performance targets?

Do you know how the Army scored overall in FY13? See next slide.

Slide 5: The Army reported to DoD for the FY13 Annual Energy Management Report a reduction in energy intensity by 14.2%, but our cumulative goal for FY13, set by EISA 2007, is 24%.

Total energy consumption remained almost flat (a decrease of .08 percent) in its goal subject buildings, while square footage decreased by 15 million square feet. Therefore, the increase in energy intensity from FY 2012 to FY 2013 was attributable to a change in *square footage* at Army installations. The contributing factors to the Army not reducing energy consumption further in FY 2013 included increased energy demand

due to returning soldiers from theater, increasing process loads at industrial facilities, and delayed appropriations in prior fiscal years.

The Army did not meet the EPA goal of 7.5% of total energy consumed be from renewable sources. We reported 1.1%.

Another key point is that the Army's progress is measured at the Army level, not installation by installation, thus having each installation focus only on their yearly goals will not result in the Army meeting the goals if all installations do not meet their yearly goals. Further, a subset of installations, based on their mission requirements, may not be in a position to achieve the goal.

Thus focusing on Net Zero allows the Army to start with the end point in mind versus focusing on the yearly goals for each federal mandate.

Slide 6: The Army manages approximately 152 installations, 13.6 million acres of land, and more than 1 billion square feet of buildings. We face significant challenges in efficiently powering these facilities and balancing overlapping and sometimes competing objectives.

- Our installations must have increased energy security, surety and reliability to execute mission-essential functions.
- The Army, like all federal agencies is directly impacted by fuel prices
- We are looking to reduce risk, improve operational capability and not degrade our natural resources
- And we must strive for each Federal mandate.
- The NZ approach acknowledges the relationship between sustainability and security; reducing resource use allows an installation to become more secure. NZ encompasses installation self-sufficiency and resiliency.

Each new mandate increases the targets or extends the reduction goals further, so even if we did achieve the FY13 goals in the current EO, a new EO will be on the horizon adding additional reductions/efficiencies. Driving improvement is essentially driving us to Net Zero.

The mandates formed the foundation and all other drivers were the impetus for the Army Net Zero Initiative.

As discussed in the prior modules and on the next slide, the Army officially kicked off the Initiative with the announcement of the Net Zero Pilot Installation Initiative.

Slide 7: On 17 February 2011, Ms. Hammack announced and invited all Army commands to nominate installations for potential as an Army Net Zero pilot installation. Commands submitted their nominated installations and supplemental data on 15 March 2014.

We received fifty-three (53) **energy** nominations and reviewed using a rigorous process intended to develop recommendations for our Senior Leaders to make the final determination. The review process was divided into two phases to assess each application, leveraging DOE laboratories (NREL, and PNNL) and expertise and Army subject matter experts.

Criteria for evaluation included:

- Command or installation-level support to pursue a Net Zero status
- Constraints or vulnerability of current natural resources
- Impact on mission critical objectives
- Energy security needs
- Installation expertise
- Installation cost sharing capability
- Resource costs
- Project development capabilities acquired from past, current or programmed
- conservation, efficiency, recycling, recovery, or generation projects
- Local regulatory climate

We identified the 8 energy pilot installations and one statewide Army National Guard location on 19 April 2011 at the Garrison Commander's Conference in San Antonio, TX. The Army's goal is for information learned at the Net Zero pilot installations to be shared with other Army installations.

One of the keys lessons learned is how crucial collaboration is. Collaboration became the cornerstone of the NZ Energy Pilot Initiative.

Slide 8: The Net Zero team Lead for energy at the Headquarters-level initiated monthly collaboration calls and periodic progress meetings with representatives from the energy pilot installations and their Commands. Cross-functional Net Zero teams were established to share and document success stories and lessons learned from the pilots. Some of the success stories will become the next Army standard as we learn more

about increased mission capabilities and cost avoidance achieved from the many activities conducted at the Net Zero pilot sites. Our collective challenge is to adopt and embed these takeaways into standard activities across all installations.

We have also partnered with other Federal agencies, such as the Department of Energy (DOE), with industry through public-private partnerships, and with municipalities and communities to develop mutually beneficial solutions at the local and regional levels.

We continue to work with the DOE leveraging highly specialized capabilities in their laboratories. Specifically, we worked with the National Renewable Energy Laboratory (NREL) to complete energy assessments and roadmaps – which we'll talk about later.

But now we are going to discuss how Net Zero Energy is defined and the order in which installations should apply NZ STRATEGIES to strive towards Net Zero. Much has been learned and many stakeholders have been engaged at the installation level in working with the Net Zero Pilot Installations and developing the Hierarchy of strategies. The hierarchy is key to understanding how to get to Net Zero Energy – and the next slide will explain why.

#### Slide 9:

So, how do you reach NZ Energy? As shown in the NZ Energy hierarchy, aggressive demand reduction through conservation measures should be the 1<sup>st</sup> and largest effort followed by maximizing efficiency. Once energy use is reduced as much as possible, energy recovery options should be considered, followed by cogeneration opportunities. Finally, renewable energy sources should be implemented to supply sufficient energy for the remaining demand with preference given for the use of renewable energy for on-site power.

On-site energy production enables each installation to plan for continuity of operations if the grid is unavailable. Power grids are increasingly vulnerable and expose Army operations to risk; therefore an alternative to this supply is needed.

Now we're going to walk you through some of the activities that have been carried out in journeying towards Net Zero Energy.

We will next go over how baselines were determined which gives planners and managers a metric against which progress toward net zero energy can be measured and present to you an overview of the various assessments and plans put together for the NZ Energy pilot installations.

Slide 10: To support the pilot initiative, ASA-IE&E provided assistance to the energy pilots on how to determine their path towards Net Zero

- We needed an energy baseline to measure success. We began by examining Army Enterprise data systems to determine baseline metrics for each installation.
- We then provided Energy Efficiency assessments to all pilots in the hope of identifying measures they could take to reduce their overall demand.
- To support the preference for onsite renewable generation, we completed renewable energy assessments at each pilot.
- We leveraged a Classified Energy Security Assessment at Fort Detrick, tailored this model to Net Zero- specific considerations, and performed an unclassified Net Zero Energy Security Assessment at FHL to serve as a template.
- We used all this information to draft roadmaps for each installation on how to reach or strive to the 2020 Net Zero Energy Goal.
- Installations will use the roadmaps – now referred to as ‘plans’ to begin implementing projects.

Slide 11: Our pilot installations represent a diverse cross-section of the Army installations

- Different Army Commands
- Large vs. small geographic footprints
- Differing climate zones
- Differing levels of energy efficiency and renewable development done to date
- Very different levels of energy consumption
- Very different prices for power

The first step in an NZE assessment is to determine an energy baseline, current energy consumption at the site, which gives planners and managers a metric against which progress toward net zero energy can be measured.

This chart depicts the energy baseline in FY10, when the pilot installations were selected.

Slide 12: The Engineering and Support Center, Huntsville completed Energy Engineering Analysis Program (EEAP) surveys for all Net Zero energy pilot installations. The goal of each EEAP survey was to identify critical energy inefficiencies at each Army installations

The Engineering and Support Center, Huntsville EEAP surveys were targeted to find energy inefficiencies and waste at the Net Zero pilot installations. These assessments looked at proven technologies (nothing complicated)

The audits for all pilot installations included assessments of 350 buildings (11.6 M square feet) and identified 345 MMBTU of savings (estimated at \$15.5M per year) through Energy Conservation Measures (ECM)!!

A Key Point garnered from the assessments is that energy efficiency is a moving target. Results today need to be continually reevaluated.

Slide 13:

Renewable Energy assessments are a critical part of building a pathway to reach net zero.

You start with tools-based assessment to help identify RE opportunities and screen out unrealistic, unneeded projects – quickly so as not to expend too much time and resources on chasing down an opportunity that just won't work.

Investigate, research, and interview other installation staff members to collect information on past assessments or issues. This is done to help understand local opportunities or obstacles which aren't readily identified through a remote, tools-based assessment.

Identify RENEWABLE ENERGY technologies and project sites at the installation.

Initiate NEPA action if required – do this as soon as possible.

Network with other stakeholders on the installation to identify potential issues. Stakeholders from master planning, environmental, Range Control, and the Plans, Analysis and Integration Office (PAIO) are top priorities

Slide 14: Once you've exhausted all other efforts to reduce, conserve, cogenerate, etc, and you are ready to move further towards Net Zero – evaluate possible sources of renewable energy. One of the key steps in assessing renewable energy opportunities is to analyze the feasibility of RENEWABLE ENERGY technologies.

Slide 15: In 2008, the Defense Science Board (DSB) concluded that the DoD's dependence on a fragile and vulnerable commercial power grid places critical military missions at an unacceptably high risk of extended disruption. And although many efforts at improving this vulnerability have been initiated since – energy security remains a challenge. In 2012 alone, there were 87 outages of eight hours or more at DoD installations - of which 98% were attributed to acts of nature (e.g. storms and forest fires) (DoD, 2013).

The Army has launched several initiatives aimed at addressing energy security at our installations – one of which focused on developing a Net Zero plan that also contains an energy security aspect. The Net Zero Energy Security Action Plan and Conceptual Methodology effort for Fort Hunter Liggett was an attempt to assess, at a high level, the level of awareness and activity regarding energy security at FHL. It introduced a methodology, which details eight steps to ensure that energy security is a part of the decision making process, and is integrated into energy system infrastructure upgrades. Under each step, specific activities were recommended that support FHL in assessing and improving its energy security. Finally, an action plan was defined, which detailed all recommended actions, and provided a suggested chronological order in which they should be performed.

Slide 16: The Energy Security Action Plan (ESAP) developed for Fort Hunter Liggett assessed the level of awareness and activity regarding energy security at FHL. The ESAP introduced an Energy Security Assessment Methodology, which details eight steps to ensure that energy security is a part of the decision making process, and is integrated into energy system infrastructure upgrades.

These steps are listed on the slide. Please take a minute to read through the steps

- Determine the energy security baseline metrics.
- Conduct an Unclassified high-level Energy Security Assessment (ESA) which incorporates the baseline metrics.
- Conduct a high-level electrical distribution system upgrade assessment.
- Determine actions required to conduct a high-level conceptual design of a Microgrid to address energy security concerns.
- Align with energy efficiency recommendations.
- Align with renewal energy recommendations.
- Determine additional metrics not presently identified, but valuable to quantifying energy security values in the future.
- Deliver assessment results/ESAP to site leadership.

IE&E conducted a similar water security assessment at JBLM as part of the Net Zero program. We aligned the Energy and Water security assessment frameworks and piloted a combined study at Fort Bliss, as shown on the next slide.

Slide 17: The Net Zero Energy and Water Security Assessment (EWSA) protocol was developed by the NDCEE for the Army as a tool for any installation to use to improve both energy and water security. The EWSA protocol was validated at Fort Bliss merging currently available Army energy and water security definitions into common indicators as shown in this slide. The EWSA protocol developed includes six steps shown on the slide[1) data call to the installation for any existing information, 2) pre-coordination, 3) onsite data collection, 4) data analysis, risk assessment, and mitigation action development; 5) validation of results and proposed mitigation measures; and, 6)

final outbrief to the Garrison leadership.] Fort Bliss has numerous resource security projects in progress or which have been completed. These include water reclamation for irrigation, potable water system monitoring, energy metering and data management, installation of renewable energy systems, and microgrids.

The expected benefits of an integrated EWSA were evident from the Fort Bliss pilot. These included a common framework for energy and water security aligning data collection and assessment efforts. An integrated approach increases the visibility of common issues so mitigation actions can be more effectively applied. It also increases the visibility of overlapping issues. In the case of Fort Bliss, this is especially evident in the need for backup power generation and updated Emergency Response Plans (ERPs). Another benefit of the integrated approach is it provides a common background for Directorate of Plans, Training, Mobilization, and Security (DPTMS) and Directorate of Public Works (DPW) for prioritization of critical facilities. An integrated approach ensures critical interdependencies are discussed in more depth and the individual utility providers have a greater understanding of these issues.

Now let's discuss the roadmaps that were completed for the pilots – how we got there and how to build one.

Slide 18: In addition to the studies conducted at the pilot installations, successful roadmaps (plans) must address:

- Behavior changes
  - Education and awareness
  - Creating dedicated teams
- Master Planning – true integrated master planning
  - New construction
  - Demolition
  - Major renovations
  - Space utilization

This figure illustrates one construct of how we envision striving towards Net Zero energy (From NREL's *Targeting Net Zero Energy at Fort Carson, Colorado: Assessment and Recommendations*)

The net zero energy installations are working on roadmaps to reach net zero by 2020. If you look at a progress roadmap, you can see a steady reduction in consumption



measured in on site Btu's through energy efficiency, shown as 'load reduction'. As time progresses, renewable or alternative energy technologies begin to phase in such as solar hot water, solar photovoltaic, geothermal, wind, or biomass. In this example you can see the potential to reach net zero.

Slide 19: The Renewable Energy assessments feed into the NZ Energy Roadmaps. Here are the elements of a Net Zero Energy Roadmap

Each Roadmap includes a project list for FY13-FY20, with recommended:

- energy efficiency improvements (e.g., bldg. envelop, HVAC equipment, lighting)
- and renewable energy projects (such as solar hot water, solar PV, geothermal, wind, or biomass)

Notice that in FY2019, there is still a heat load remaining. The 2020 line shows the potential for future solar and geothermal to address this, but the key is the installation's journey towards Net Zero while achieving Net Zero may not be fiscal prudent.

Slide 20: These figures are from the West Point and OR ARNG energy roadmaps.

From NREL's:

*Targeting Net Zero Energy at US Military Academy West Point Assessment & Recommendations*

*Targeting Net Zero Energy at Oregon Army National Guard Assessment & Recommendations*

Next we'll showcase a stellar example (the Oregon Army National Guard) and go over best practices and lessons learned

Slide 21: The Oregon Army National Guard has been making steady progress on their NZ energy efforts and have been very resourceful in their approach to funding and contracting mechanisms as well as their diversity of projects in terms of renewable energy sources:

They've installed solar panels on rooftops of their warehouses, readiness centers and armories. They've completed small and large scale wind projects. They installed geothermal projects and constructed Biomass pellet boilers that are anticipated to have sizable thermal energy savings, a reduction in fuel cost from liquid propane gas (LPG) and savings from more efficient biomass boilers and sizing. They completed a geothermal power seismic study and a Behavior Based Energy Efficiency study.

It will be interesting to see what other innovations they come up with in their journey to Net Zero. As of 1st quarter 2015 they were working with the Army Corps of Engineers on a **biomass** plant and a compressed air energy efficiency project.

But, the most interesting energy project the ORARNG has been working on is **wave energy**. Installation staff at Camp Rilea are testing a wave energy converter that, described in the most simplest of terms, harnesses the pressure of a wave on the ocean floor and converts it into energy. The testing is a result of several years' worth of efforts to develop this cutting edge new technology.

### **Participants and stakeholders include:**

Camp Rilea and the ORARNG – their interest stems from developing renewable energy to meet their NZ Energy goals – but most importantly wave energy could provide a reliable source of energy in the event of a regional disaster.

Interest increased after Governor John Kitzhaber signed House Bill 4042, which authorized net-metering for renewable marine energy.

An Oregon Wave Energy Trust grant and private funds are being used for the project.

The project will provide internship opportunities for students at Tongue Point Job Corps or Clatsop Community College's Marine and Environmental Research and Training Station and local tradesman will be used for parts fabrication. A retired US Navy Captain serves as the project's design engineer.

**The Oregon Dungeness Crab Commission** has voiced their concerns about potential impacts. As a National Guard training site, Camp Rilea conducts live-fire exercises. Currently, these exercises take place over areas considered prime Dungeness crabbing grounds. So, they worked out a system that when the training exercises are done and the ranges are no longer 'hot', they notify the U.S. Coast Guard and a **safety zone** which was set up to keep fishermen and recreational users out of the area is lifted. Installation officials say this is a great example of compatible use and are confident that it will continue with the introduction of wave energy devices.

But local fishermen are not 100% convinced. And this is only a test of one type of converter. There are several wave energy converters that could be tested at the study site. It could be **several more years of testing** before a viable system is in place at Camp Rilea.

Now We'll go over Best practices learned from working with the pilot installations for three plus years

Slide 22: Capturing lessons learned and best practices from activities at our Net Zero pilot installations is a crucial step in institutionalizing Net Zero across the Army enterprise.

- Let's look first at thermal building envelop analysis. Infra-red thermography was completed on the largest buildings as well as the largest energy-using buildings at the pilot installations. This enabled installations to identify areas with heat loss, then target those areas for repairs.
- Installing Energy Management Control Systems give the installation Energy Manager the ability to control any energy-consuming device that's connected to the system. This also allows the Energy Manager to control those devices for demand reduction.
- Employing a Resource Efficiency Manager whose primary function is to reduce energy consumption and reduce the cost of energy at the installation. They work with the installation's existing staff to enhance energy conservation measures.

Slide 23:

- Key to Net Zero Energy success is to leverage alternative or third-party financing. The primary mechanisms are Energy Savings Performance Contracts (ESPCs) and Utility Energy Service Contracts (UESCs). Under these contract vehicles, the ESPC's Energy Services Company or the UESC's Utility provider use their own funding to implement energy reduction projects. They are "paid back" for their investments through the energy savings realized from the project.
- Finally, conducting Energy Master Planning is an integral part of the Real Property Master Plan. This enables the integration of efficiency and renewable energy options that wouldn't otherwise be feasible in a single building. Examples include the development of a Central Utility Plant to serve an entire Brigade complex, which is easier to maintain and typically more cost effective than individual boilers per building or longer distribution lines necessary with only one installation-wide utility plant.

I will briefly review some of the Lessons Learned from the pilots to date.

Slide 24: Lessons Learned

At the onset of the Net Zero Pilot Initiative

### **Resources – Funding or Data**

- Net Zero is an Initiative – a management philosophy; it does not have a separate funding stream.
- Utility rates and renewable energy resources make projects difficult at many installations
- NZEI assessment financials should be viewed as an estimate useful for planning purposes, but private sector financing mechanisms may require additional detailed analysis
- Resource Commitment to implementation support after an assessment should be part of the upfront project planning and budgeting.
- Data Collection

- ☐ Without good data the quality of assessments decreases
- ☐ Metering is key to understanding the baseline and measuring progress

## Support

- Net Zero must have Command support
- While driven by goals and mandates, the spirit of competition has been more powerful
- Behavior/culture change is needed in addition to technology

## Technology

- Many installations are interested in emerging technologies.
- Currently, Thermal Energy is the most difficult to accomplish

## Integration

- Nexus with Water and Waste – All projects must account for tradeoffs between water, energy, and waste
- Interconnection
  - ☐ Infrastructure issues must be aligned with EE and RE recommendations
  - ☐ High penetration of RE on an installation will likely require coordination, special contracts, or negotiations with the serving utility to ensure the ability to interconnect systems as they can exceed existing export limits
  - ☐ Storage and microgrids are an increasing need
  - ☐ Integration within existing installation management is key
  - ☐ Construction/ renovation designs need to change to sync with net zero goals
  - ☐ Focus on integrated planning is key
- Energy Security
  - ☐ Net Zero does not equal energy security
  - ☐ Correctly designed Net Zero can support greater energy security

## Slide 25: Lessons Learned as the Initiative Progressed

In working with the Pilot installations, we have collected quite a few 'Lesson Learned' over the three + years of journeying to Net Zero. Most recently, we sponsored a recent publication by NREL "*Army Net Zero Energy; Lessons Learned in Net Zero Energy.*" The publication builds on our previous Net Zero Energy efforts and is based on feedback received from energy team members at each of the Net Zero Energy pilot

sites and multiple other sources. The publication reported elements in addition to what we had already gathered and are reported here:

### **Knowledge of the Energy Team**

- The capability, motivation, dedication, and capacity of the Net Zero Energy program leads are some of the most significant factors that affect an installation's success in pursuing Net Zero Energy.
- Net Zero Energy implementers and teams need appropriate training and skills. In addition, they should recognize and utilize all the available resources they will need to successfully implement projects.

### **Planning**

Advanced planning for energy projects and incorporating energy as a primary consideration in designs are critical to the success of implementing the Net Zero Energy principles.

- Maintaining flexibility in pursuit of finding the right procurement approach for each project dramatically increases the likelihood of success.

The study confirmed that leadership support and engagement at multiple levels is critical to an effective Net Zero Energy program – this includes Command support from both the mission and installation (garrison). The report also noted the following points on integration in terms of an holistic approach:

- The Net Zero Energy approach should be an interdisciplinary, well-integrated, and holistic methodology of assessing, planning, developing, and implementing Net Zero Energy projects.
- Understanding the integration implications of proposed Net Zero Energy projects—between each other, between projects and existing systems, and between projects supporting Net Zero Water and Waste—is crucial to implementing a cohesive and effective Net Zero Energy program.

Slide 26: In gathering best practices and lessons learned and conducting all the assessments at the pilot installations the following 'Net Zero Solutions Summary' was developed. The chart shows the results and recommendations brought forth from technical assistance provided to the net zero energy pilot installations to develop a baseline, conduct energy efficiency and renewable energy assessments, complete plans – formerly known as roadmaps and develop energy security assessments and action plans. In looking at the chart, by implementing ENERGY EFFICIENCY and RENEWABLE ENERGY options, most of the Net Zero energy pilot installations are able to reach the Net Zero goal. However while these options may 'in theory' get an

installation to Net Zero – in reality these projects may be too cost prohibitive at this time to consider under normal funding mechanisms.

And, It should be noted that the Zero in Net Zero is not necessarily absolute. The Army recognizes the challenges in achieving total Net Zero due to legal and technical issues and the likelihood that it may not be cost effective. As previously stated in Module 2, a **key point is that we are journeying towards Net Zero. Success is measured, not by achieving an absolute Zero but moving as far along the journey as possible in a fiscally prudent manner.**

Now let's go over funding strategies.

Slide 27: Energy projects can be funded directly through agency or government budget mechanisms. Funding through these mechanisms has the advantage of reduced project financing costs. Government-funded projects are not, however, eligible for the benefits of RENEWABLE ENERGY generation tax credits.

MILCON – Funding for any construction, development, conversion, or extension of any kind carried out with respect to a military installation

SRM- Program to fund DoD facility maintenance and improvement projects, including the repair of roads, roofs, barracks, family housing, medical facilities, and operational support buildings. More recently, renewable energy projects have served as a priority for SRM funds.

The Army cannot rely on appropriated funds alone to fund the energy projects needed to meet Federal requirements. Additional funding options are available and as discussed in the previous slides are considered a best practice! Another best practice not previously mentioned is the **Army's Office of Energy Initiatives (formerly known as the EITF)** – whenever possible they should be used as a resource. Although their focus is on large scale (<10MW) renewable energy projects, they have documented a process for developing projects that can be invaluable to an installation energy program manager – whether or not they're pursuing a project that's 10 MW – 5MW or 0.1kw. I'll go into more detail on that process – *the Army's Guide on Developing Renewable Energy Projects Leveraging Private Sector Finance* later, but first let's review the authorities used to finance ENERGY EFFICIENCY and RENEWABLE ENERGY projects. Also, additional Information on alternative financing mechanisms can be found on the FEMP Financing Mechanisms website at [www.femp.energy.gov/financing/mechanisms.html](http://www.femp.energy.gov/financing/mechanisms.html).

Slide 28: The purpose of ESPCs and UESCs are to provide energy improvements to Army buildings, structures, and facilities. They provide capital for such projects where existing Army capital funding is not available. The 25 year contract term of an ESPC is

attractive in that it allows for accomplishing energy savings projects with longer term paybacks and may be used to bundle a number of installation projects with differing payback periods. Some installations prefer using a UESC as there's a continuity of service that it involves working with existing personnel on site – the utility company that provides energy services. Because UESC does not provide a requirement that the utility contractor guarantee savings, projects should be carefully reviewed to limit the risk to the Army that savings sufficient to cover the UESC contract costs are attained. Project planning should include providing necessary contract administration and oversight resources.

Slide 29: PPAs can be combined with the use of other energy acquisition authorities, including ESPC, UESC, and EUL. PPAs are a contracting and financing mechanism by which a utility or other energy developer constructs or develops, owns, operates, and sells the energy output (generally electricity) produced by such energy facility or project. PPAs are attractive to 3<sup>rd</sup> party investments as they provide tax credits the Army is not eligible for.

Slide 30: EUL is a Real Property Leasing authority by which the Army may lease available, non-excess real property (including land and facilities) to a private entity/developer for cash and/or in-kind consideration. EUL enables the Army to leverage the expertise of the private sector through an initial leasing structure to finance the development of energy resources on Army lands. The EUL lessee develops the Army-approved energy project, including a financing and project “sharing” mechanism whereby the Army can share in the proceeds relating to the energy project without assuming the financial risk of the development. Private developers are attracted to EUL projects because the projects provide the developer the right to access and use Army land in a secure environment. In addition, EUL provides the opportunity for the developer to potentially sell energy to the Army.

The Army real property provided may range from a single roof to thousands of acres of land. The structuring of the EUL and the requirements of the EUL legislative authority ensures that a portion of the benefits of the EUL project are targeted to the installation concerned. While the EUL process generally offers a shorter timeline from project initiation by the Army to lease award and project development than other Federal Acquisition Regulations (FAR)-related contracting authorities, there still remains significant project challenges that need to be addressed by the Army, including environmental requirements, and project oversight and administration responsibilities.

All of these regulations and technologies and funding and contracting authorities can be challenging – recognizing a need to support installations and meet federal mandates, the Army decided to create a new entity to sort through the requirements and technicalities – as discussed on the next slide.

Slide 31: In September of 2011, the Secretary of the Army stood up the Energy Initiatives Task Force (now called the Office of Energy Initiatives) to serve as the central management office for partnering with Army installations to implement cost-effective, large-scale, renewable energy projects, leveraging private sector financing.

The OEI is helping the Army improve its energy security and achieve the goal outlined in the National Defense Authorization Acts of 2007 and 2010 of producing or procuring 25 percent of its installation energy from renewable sources by 2025.

The Army has teamed with the Air Force and Navy to establish a goal one gigawatt of renewable energy projects over the same period.

The OEI focuses on renewable energy projects that are commercially proven technologies – solar, wind, biomass and geothermal - 10 megawatts or greater, located on or adjacent to Army land in the U.S.

The OEI is dedicated to working with the private sector to streamline the process of large-scale renewable energy project approval and execution. This approach will help speed overall project development timelines to ensure the best value to the Army and private sector.

As shown on the next slide, the OEI seeks to create a balanced pipeline of opportunities that will serve three driving principles: Energy security, meeting federal goals and mandates and ECONOMICS!

Slide 32: The Army requires access to secure energy sources to accomplish its mission. In addition, installations require cost effective, reliable, and sustainable energy sources to sustain operations. Overreliance on a vulnerable commercial power grid jeopardizes the security of Army installations and mission capabilities. In response, the Army is securing installations with energy that is clean, reliable, and affordable, and has committed to a goal of developing 1 gigawatt (GW) of renewable energy to fulfill this vision.

The challenge lies in the fact that at times, three elements of this overall vision—energy security, mandates for clean energy, and economic benefits— often compete with one another. While it is possible to secure installations with additional energy security from renewable sources generated on Army lands, it may not always be affordable to do so. The addition of infrastructure such as control systems or micro-grids can increase energy security benefits, but may lower economic benefits. The challenge is to balance these competing elements on a project-by-project basis, to best support the Army enterprise and installation energy goals.

Slide 33: EVALUATING RISKS - 8 ASSESSMENT CRITERIA



The OEI developed a framework of 8 Assessment Criteria as a tool to consistently evaluate and manage risks that may threaten project completion. The 8 Assessment Criteria are used to assess risks and support objective decisions that direct Army resources to projects that not only create value, but are cleared of excessive risks. If risks are too high, project efforts should be suspended. Each criterion can be rated on a three-point scale (red, yellow, or green) with red indicating a high level of risk, yellow indicating moderate risk, and green indicating minimized risk. These Criteria can be adapted for evaluation of renewable or traditional power generation projects and provide a proven, standardized framework for evaluating project risks of small, medium and large-scale projects.

Installations pursuing renewable energy projects large-scale or distributed scale should access the OEI's website for more information on developing their projects.

Additionally, the FEMP Guide provides a similar framework of categories and questions for project development. The FEMP Guide can be found at:

<http://www1.eere.energy.gov/femp/pdfs/large-scalereguide.pdf>

Slide 34: This concludes, Module 3 of the NZ online training Net Zero Energy. Module 4 will cover Net Zero Water.

Additional information on Net Zero and other Army energy and sustainability programs and policies is available on our office website.

Thank you for your attention.

## **APPENDIX D**

### **Net Zero Training Module 4 Net Zero Water**



Appendix D Net Zero  
Training Module 4



Appendix D NZ Water  
Module 4 Speaker Not

## **Appendix D**

***Task 0818, "Army Net Zero Prove Out  
Final Net Zero Training Report***



# Army *Net Zero*

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## Army Net Zero Training Module 4: Net Zero Water

Assistant Secretary of the Army  
(Installations, Energy &  
Environment)



# Module 4 – Net Zero Water



- Learning Objectives
- Driving Forces Behind Net Zero Water
  - Regulatory
  - Threats to Continued Mission
- Net Zero Hierarchy
- Pilot Activities, Water Balance and Roadmap Reports
- FEMP and EPA WaterSense BMPs
- Stellar Examples and Lessons Learned
- Funding Mechanisms



# Learning Objectives



1. Review the Army definition of Net Zero Water and the driving forces (Federal mandates, DoD and Army regulations and goals) behind striving towards Net Zero Water in the Army.
2. Explore how water issues (such as drought, scarcity and climate change) impact Army installations.
3. Understand the concepts, data and resources required to develop a baseline, measure progress, develop a plan, and assess water security.
4. Identify resources available to help plan for and implement Net Zero Water projects.



# Net Zero Water Federal Drivers



Title	Focus Area	Key Content Related to Net Zero Water
Energy Policy Act of 1992 and 2005	Water conservation	Required water conservation measures with life-cycle paybacks of <10 years be implemented
Energy Independence & Security Act of 2007	Section 432 - Comprehensive energy and water evaluations	Requires water evaluations of 25% of covered federal facilities each year. Implementing water efficiency measures identified in these evaluations and following up on these measures.
	Section 438 - Stormwater	Defines stormwater control approaches for new federal construction projects
EO 13423 Strengthening Federal Environmental, Energy, and Transportation Management, 2007	Water use in Federal buildings	Establishes water use reduction goals for federal buildings
	Reduce water consumption intensity	Reduce water consumption intensity 2% annually through FY 2015 or 16% total reduction by the end of FY 2015 (baseline FY 2007) through life-cycle cost effective measures
Executive Order 13514 Federal Leadership in Environmental Energy and Economic Performance	Reduce potable water consumption intensity	Reduce potable water consumption intensity by 2 percent annually through FY2020, or 26 percent by the end of FY2020, by implementing water management strategies including water-efficient and low-flow fixtures and efficient cooling towers;
	ILA Water consumption	Reduce industrial, landscaping, and agricultural water consumption by 2% annually or 20% by the end of FY 2020 (baseline FY 2010)
	Water consumption	Minimize consumption of water through cost-effective, innovative strategies, such as highly reflective and vegetated roofs.
	Procurement	Ensure 95% of new contract actions for products and services are Water efficient and Environmentally preferable
	Net zero buildings	Manage existing building systems to reduce consumption of water

## What the Army Reported in FY13

Focus Area	Federal Mandate	Measure	Goal	Army Reported in FY13	Did the Army Meet Goal in FY13
Reduce Potable Water Intensity	EO 13514	Relative to FY 2007 baseline Gallons of water used per square foot of facility space.	-12% annually	-26.6%	Yes

# 2010 and 2014 QDR: Climate Change



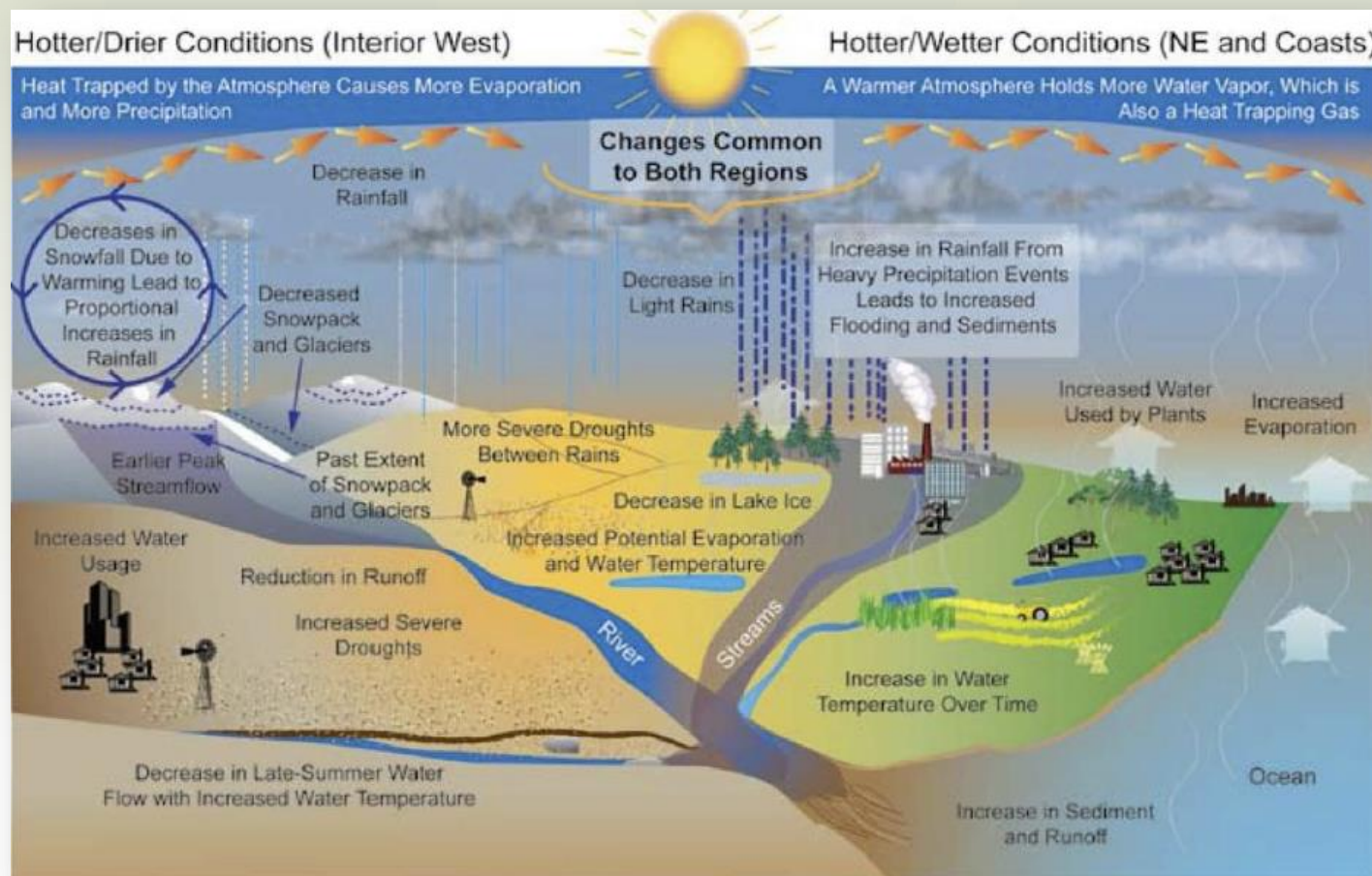
- Climate change may exacerbate water scarcity
- DoD will need to adjust to the impacts of climate change on our facilities



# The RAND Report on Climate Change



## Projected Changes in Water Cycle Due to Climate Change



According to the RAND Report - Projections of future precipitation generally indicate that northern areas of the United States will become wetter, and southern areas, particularly in the West, will become drier.

Key Trends That Will Shape Army Installations of Tomorrow, 2013 , RAND Corporation, page 43;  
[http://www.rand.org/content/dam/rand/pubs/monographs/MG1200/MG1255/RAND\\_MG1255.pdf](http://www.rand.org/content/dam/rand/pubs/monographs/MG1200/MG1255/RAND_MG1255.pdf)

Water Sustainability Assessment for Ten Army Installations  
[http://www.aepi.army.mil/docs/whatsnew/ERDC-CERL\\_TR-11-5%20Water%20Sustainability%20Assessment%20for%20Ten%20Army%20Installations.pdf](http://www.aepi.army.mil/docs/whatsnew/ERDC-CERL_TR-11-5%20Water%20Sustainability%20Assessment%20for%20Ten%20Army%20Installations.pdf)





# Army Water Security Strategy Framework



**These six factors provide a conceptual framework for the types of issues/actions that require attention to achieve Army water security**



*Army water security is the assurance that water (potable and non-potable) of suitable quality will be provided at rates sufficient to fully support the Army wherever it has, or anticipates having, a mission in the future.*

Army Water Security Strategy:

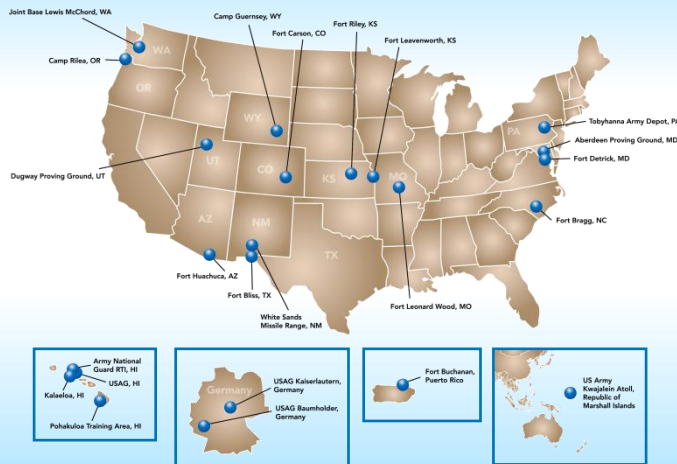
<http://www.aepi.army.mil/docs/whatsnew/ArmyWaterStrategy.pdf>



# Net Zero Water Pilot Installations and Army HQ Net Zero Team



## Water Nominees



## Water Pilot Installations



# Net Zero Water Hierarchy



**A Net Zero WATER Installation** reducing overall water use, regardless of the source; increasing use of technology that uses water more efficiently; recycling and reusing water, shifting from the use of potable water to non-potable sources as much as possible; and minimizing interbasin transfers of any type of water, potable or non-potable, so that a Net Zero Water installation recharges as much water back into the aquifer as it withdraws.

## Actions:


- Contribute to the Army Campaign Plan's water security Major Objective
- Reduce freshwater demand through water efficiency and conservation
- Access/develop alternate water sources to offset freshwater demand
- Develop water-efficient green infrastructure
- Implement low-impact development to manage storm water




# Example of Site-Specific Custom Tailored Net Zero Water Definition



This is an example of how one Army Net Zero Water pilot installation (Fort Riley) modified the Army's Net Zero Water definition to custom fit their own.



## Net Zero Water



**Army Definition:** A Net Zero Water Installation limits the consumption of freshwater resources and returns water back to the same watershed so not to deplete the groundwater and surface water resources of that region in quantity and quality over the course of a year.

**Fort Riley Definition:** By FY2020, Fort Riley will limit the consumption of freshwater resources and return water back to the regional watershed so as not to deplete the groundwater and surface water resources of the region in quantity and quality over the course of a year.

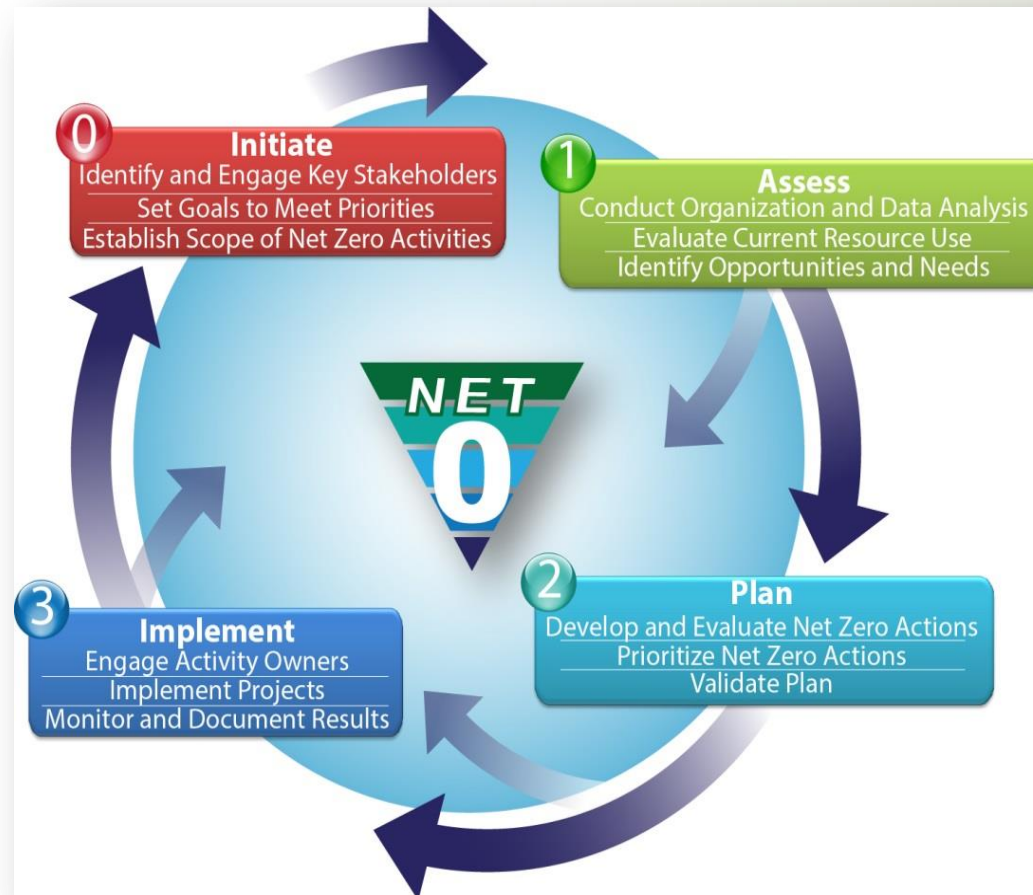
Note this was copied from a brief prepared by the installation prior to the official issuance of the Army's 28 January 2014 Net Zero Installations Directive.



# Implementation Framework



## Water Balance



**Implement  
BMPs**

**Evaluate  
Opportunities  
and Create a Plan**



# PNNL's Water Balance and Roadmap Programmatic Summary



## Water Balances and Roadmaps (Plans) developed for each Net Zero Water Pilot Installations:

- Camp Rilea
- Fort Bliss
- Fort Buchanan
- Fort Carson
- Aberdeen Proving Ground
- Fort Riley
- Joint Base Lewis-McChord
- Tobyhanna Army Depot

### Water Balance:

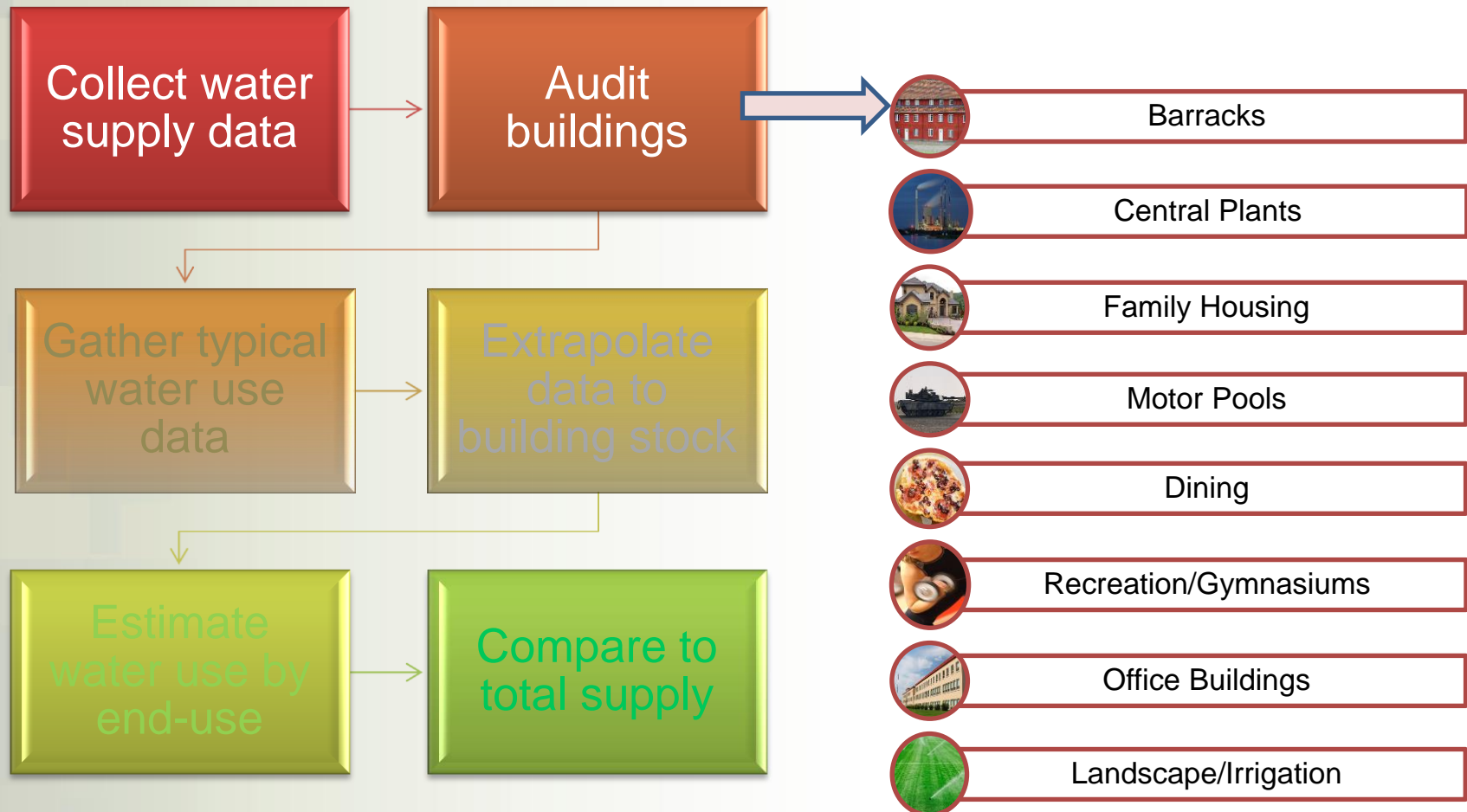
Quantifies water use at the equipment level and identifies key areas to target for water reduction and efficiency improvements

### Net Zero Water Plan:

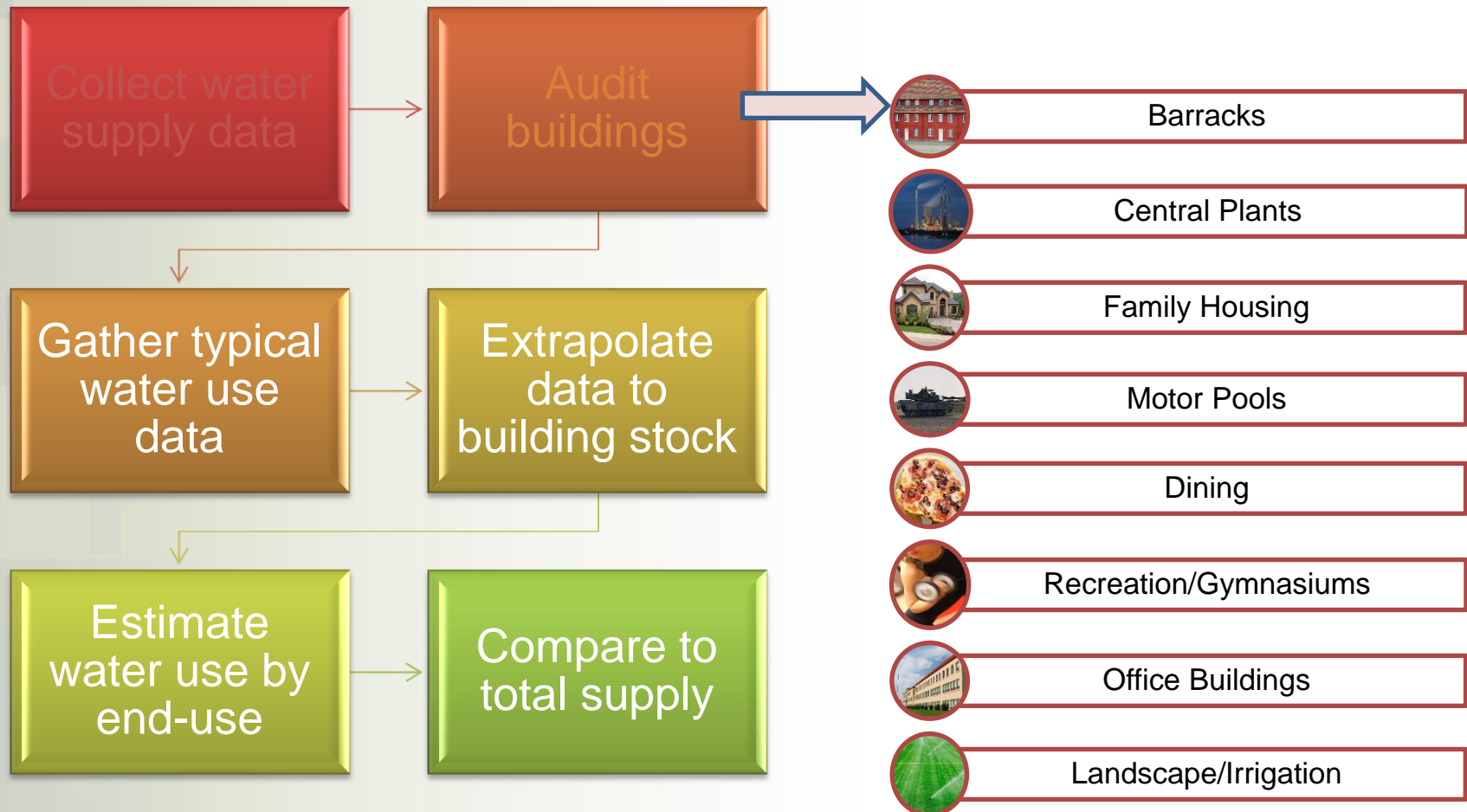
Identifies water conservation measures and performs a life-cycle cost analysis for each to guide decision-making.



# Water Balance Approach

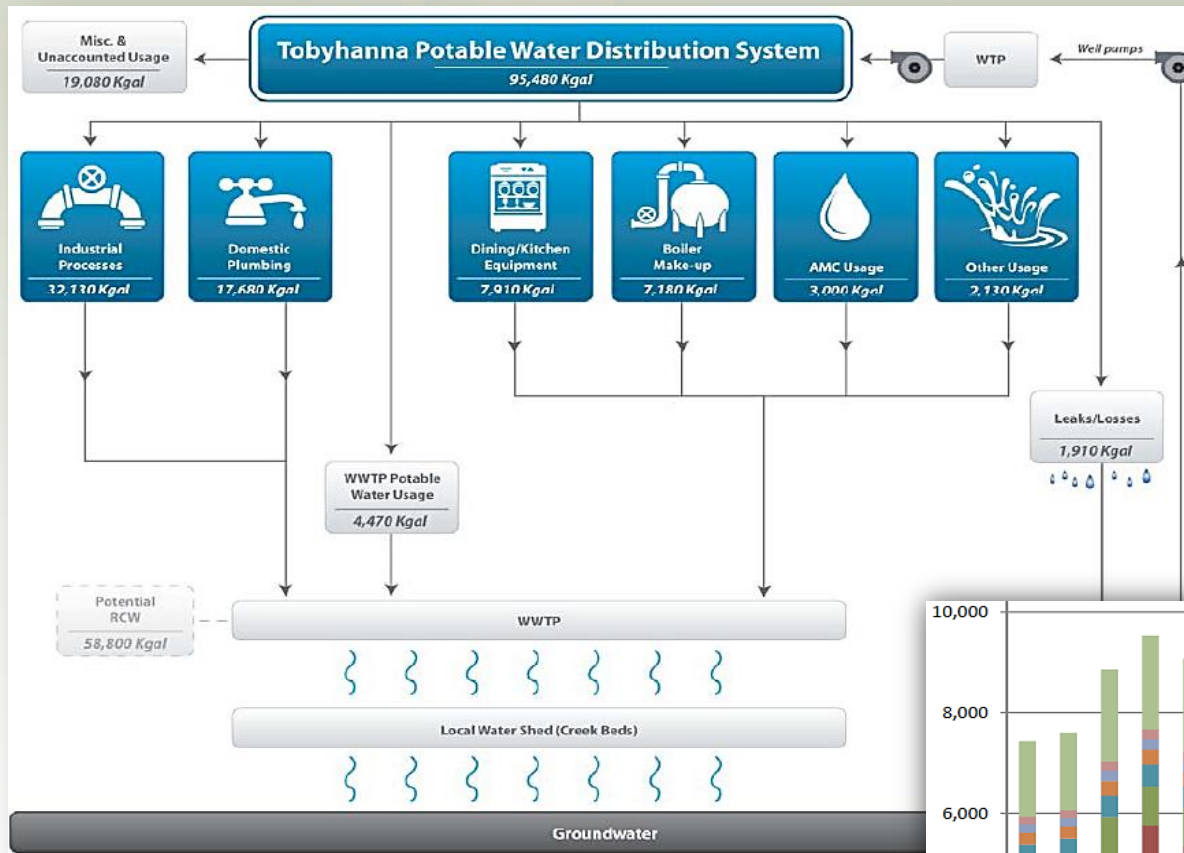


# Water Balance Approach



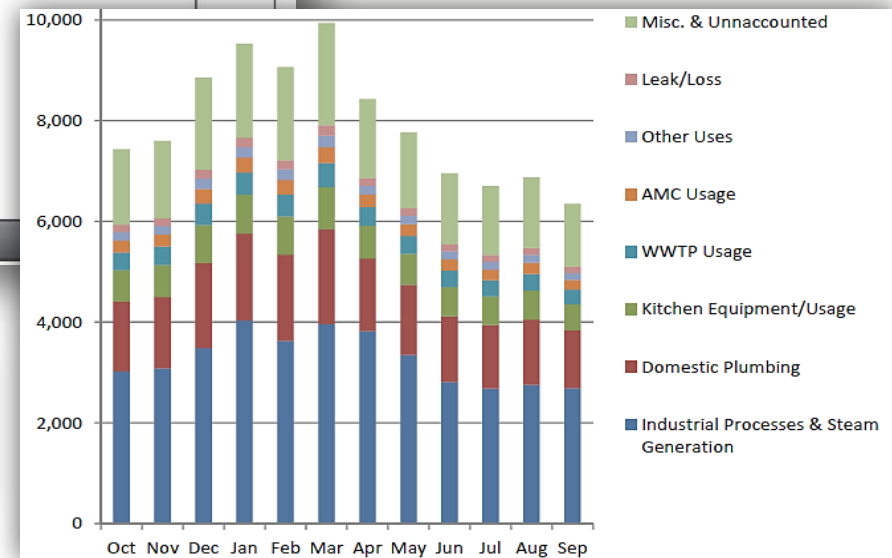


# Net Zero – Water Balance



**Results of Tobyhanna's water balance is depicted here as a water flow diagram of it's potable water distribution system, illustrating major water uses and ultimate discharge of each use**

**As shown here  
Tobyhanna's annual water  
usage varies by season**



# Water Roadmaps or Plans



- **Water Balance**

- ☐ Identify largest end-users
- ☐ Set priorities

- **Water Efficiency Opportunities**

- ☐ Perform Life Cycle Costs (LCC) analysis on measures
- ☐ Rank order projects
- ☐ Include technology and behavioral changes needed

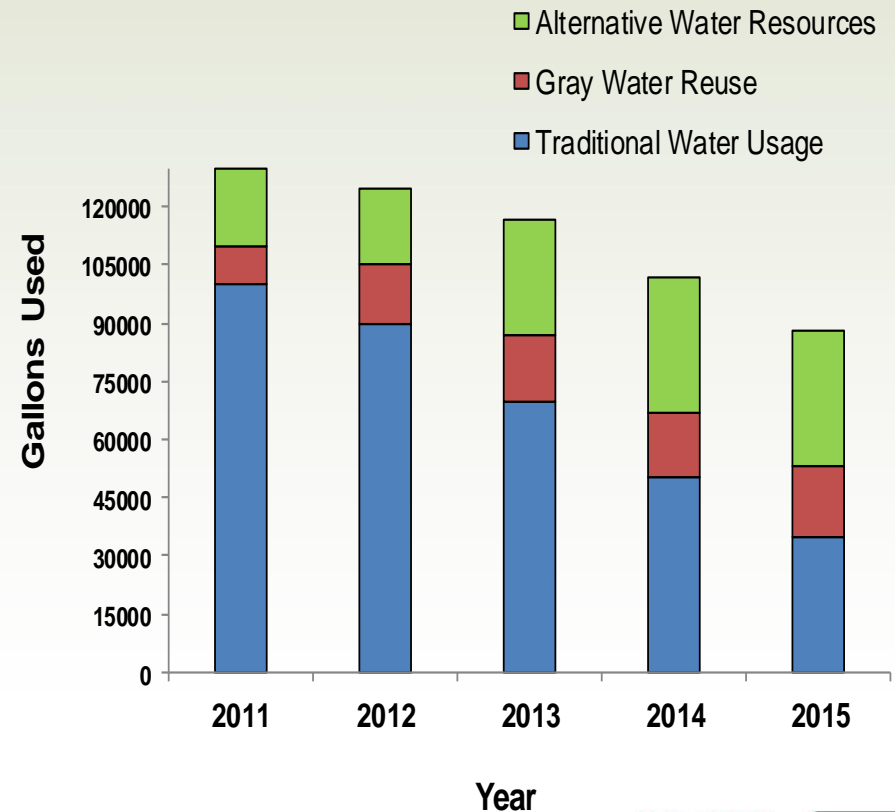
- **Roadmap Workshop**

- ☐ Collaborate with site
- ☐ Set priorities
- ☐ Identify funding
- ☐ Determine acquisition strategy

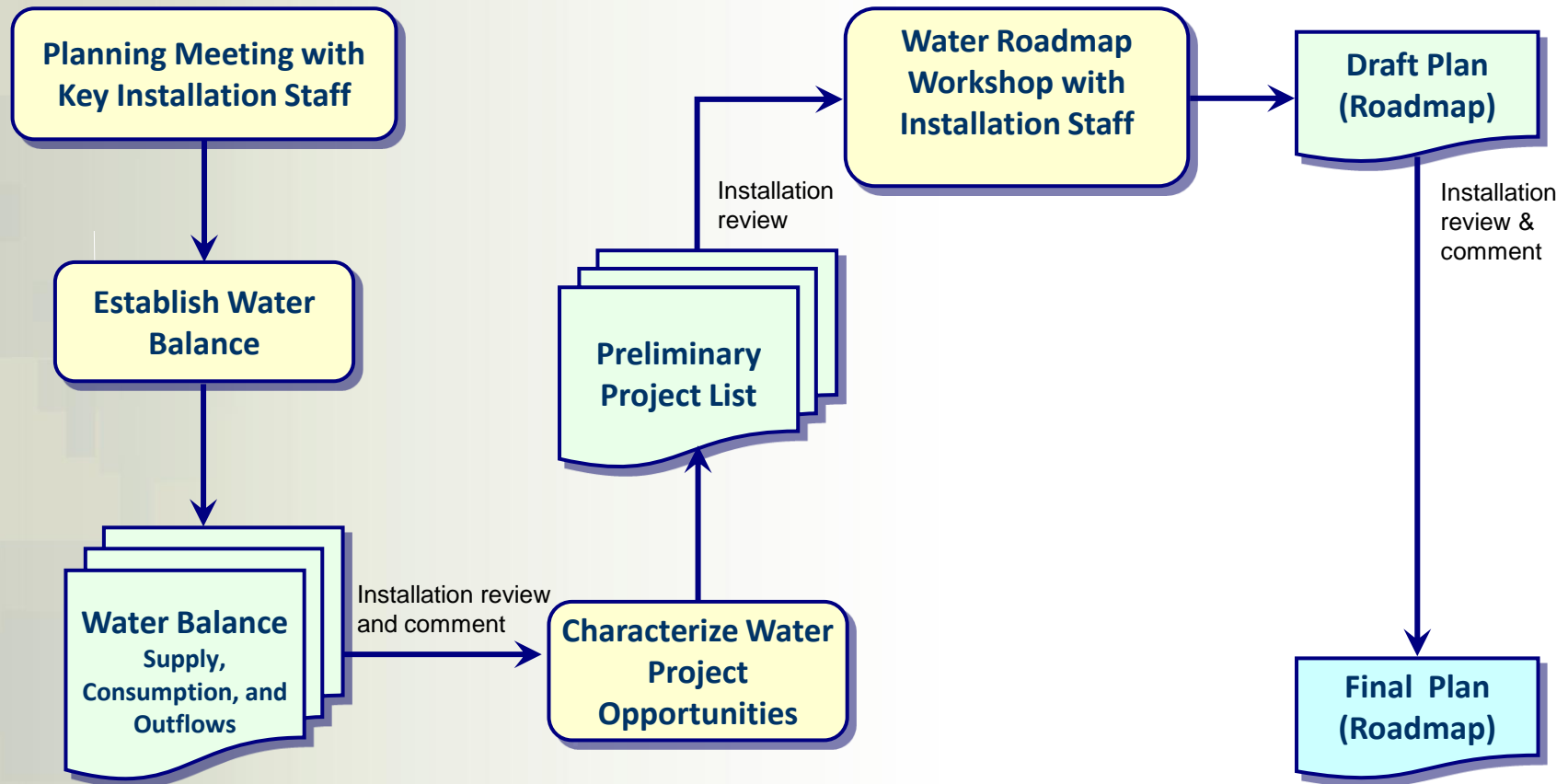
- **Roadmap and Master Planning**

- ☐ Finalize strategy
- ☐ Incorporate into master planning

## Example Installation Water Use Profile



# Plan (Roadmap) Process



# Water Scoring Activity - PNNL



Camp Rilea NZW Evaluation Score Sheet		Plumbing Fixtures	Irrigation	Kitchen	Laundry												
<b>Evaluator:</b>	<b>Weight</b>																
<b>Water Supply and/or Consumption Impacts</b>	<b>25%</b>																
S1. Does the project have a significant reduction on potable water use?																	
S2. Does the project help to reduce "consumptive" water use?																	
S3. Does the project encourage improved water use behavior by installation personnel?																	
S4. Does the project continue to perform at its initial level without significant degradation over time?																	
S5. Does the project substitute alternative sources of non-potable water for potable water?																	
<b>Mission Risk Reduction</b>	<b>15%</b>																
MR1. Does the project diversify water supply sources, thereby increasing water security?																	
MR2. Will the project be more reliable than the system/components being replaced?																	
MR3. Will the project help ensure successful mission activities in the face of an unforeseen water emergency?																	
<b>Cost Implications</b>	<b>35%</b>																
C1. Does the project save money from a life-cycle cost perspective?																	
C2. Does the project reduce the need for maintenance or major overhauls?																	
C3. Does the project reduce the need for human (operational) oversight?																	
<b>Implementation Risk</b>	<b>25%</b>																
IR1. Can the project be implemented with alternative funding sources (ESPC/UESC)?																	
IR2. Can the project be implemented with SRM funding within the installations budget constraints?																	
IR3. Will the project likely be implemented when needed, given funding and other uncertainties?																	
<p>* Score based on the following system:</p> <table border="0"> <tr> <td>Very Strongly/Certainly</td> <td>10</td> <td>Marginally/Possibly</td> <td>2</td> </tr> <tr> <td>Significantly/Highly Likely</td> <td>7</td> <td>No Impact</td> <td>0</td> </tr> <tr> <td>Moderately/Likely</td> <td>5</td> <td>Not Applicable</td> <td>NA</td> </tr> </table>						Very Strongly/Certainly	10	Marginally/Possibly	2	Significantly/Highly Likely	7	No Impact	0	Moderately/Likely	5	Not Applicable	NA
Very Strongly/Certainly	10	Marginally/Possibly	2														
Significantly/Highly Likely	7	No Impact	0														
Moderately/Likely	5	Not Applicable	NA														

Participant's at the Camp Rilea Water Balance and Roadmap Workshop used this questionnaire to score and rank potential projects



# Water Scoring Activity - NDCEE

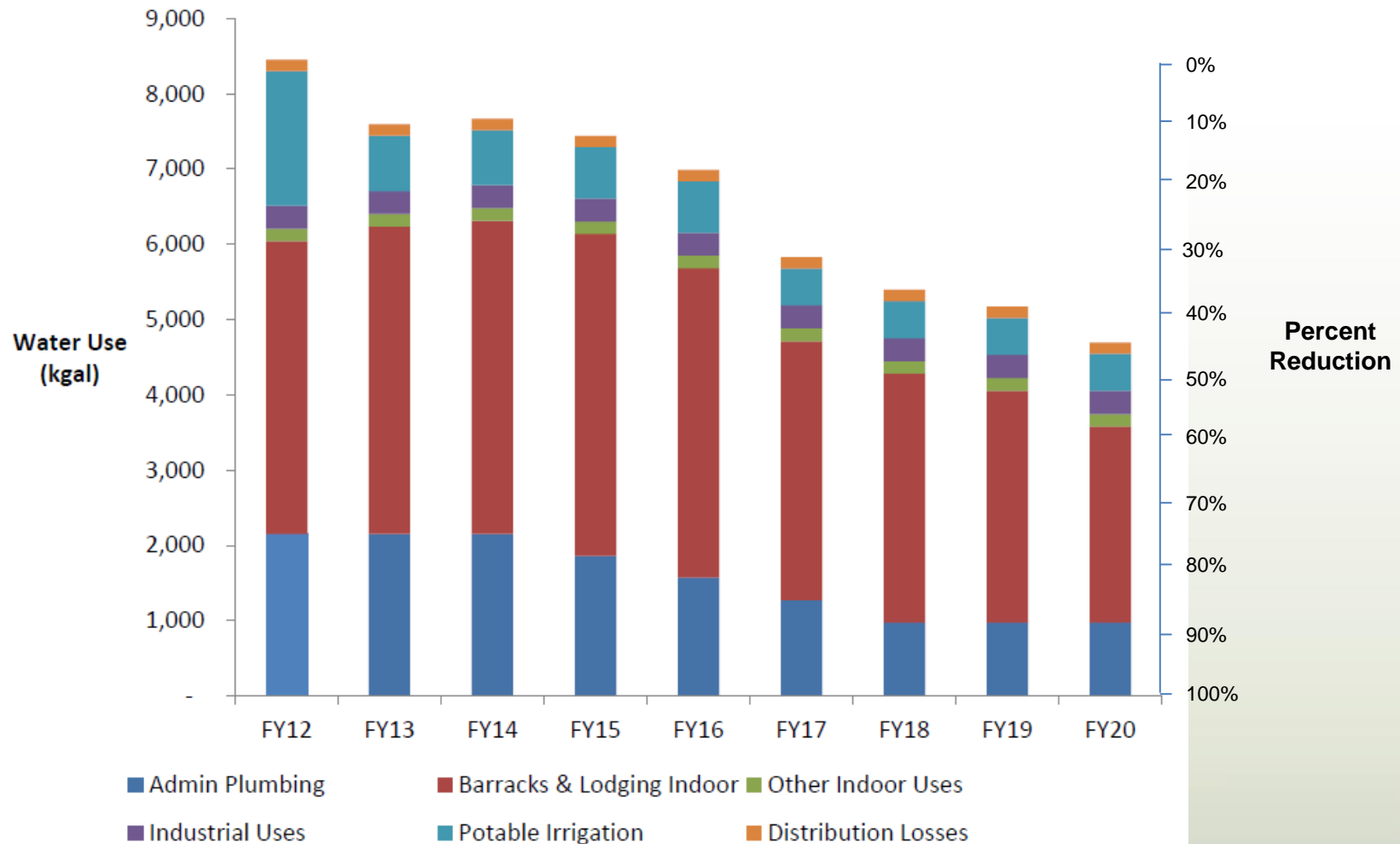


Ref ID	Net Zero Action	Water		
		(Mgal/yr water use reduction)/(baseline Mgal/yr water use)		
		Level	Calc	Comment
39W	Replace existing systems, such as bathroom fixtures, air handling units, irrigation controls with EPA WaterSense approved equipment	Less than 1%	0.279%	
40W	Acquire lower water-using systems (tactical and non-tactical): toilets and bulk purchase, composting toilets, and water-efficient wash-racks; base camps could be test locations for systems that could possibly be deployed to conserve and recapture water (implement policy/procedure)	Less than 1%	0.279%	
41W	Irrigation upgrades, landscape conversion, xeriscaping, other landscape water conservation measures	10% <= Impact < 30%	13.248%	based on Summary Table 6.1 in PNNL Roadmap
42W	Reclaim gray water from showers, dining facilities, and sinks and reuse in toilets or landscaping in accordance with applicable laws and regulations	Impact > 30%	279%	
43W	Capture lost water/re-direct water to other uses and reuse water where possible and economical	10% <= Impact < 30%	279%	
44W	ESPC #7 Includes purple pipe for the parade grounds and ball fields to use reclaimed water available from EPWU. Also includes irrigation system improvements and xeriscaping.	1% <= Impact < 10%	1.470%	Appendix E in PNNL Roadmap, projects 56 +59

Example of Water Scoring Activity. The drop down menu is depicted for NZA 41W. The user selects a range from this menu and this automatically assigns the score as well as the color coding.



# Example – Water Use Projections





Of note is that while *water use* is decreased, Camp Rilea does not achieve Net Zero Water in 2020 through conservation measures alone. Net Zero also requires Camp Rilea to find avenues for both reclaimed water and direct potable reuse.



# PNNL's Pilot Summaries



Potable Water Use Intensity (gal/sq. ft.): FY07(baseline) FY12(current) FY20(target) FY20(projected)

					
		63	46	32 <sup>1</sup>	39 <sup>1</sup>
ABERDEEN PROVING GROUND	<p><b>Where is Aberdeen Proving Ground now?</b></p> <ul style="list-style-type: none"> <li>Predominant water uses: domestic plumbing is <b>25%</b> of total; industrial process is <b>22%</b> of total</li> </ul>				
	<p><b>Where is Aberdeen Proving Ground headed?</b></p> <ul style="list-style-type: none"> <li>Net Zero water objective: Pursue water efficiency projects and alternative water resources to achieve a 26% reduction of potable water use by FY 2015 and a 52% reduction by FY 2020</li> </ul>				
	<p><b>How will Aberdeen Proving Ground get there?</b></p> <ul style="list-style-type: none"> <li>Reclaim water from Canal Creek groundwater treatment plant and pursue other sources of alternative water</li> </ul>				
		23	18	11	10
CAMP RILEA	<p><b>Where is Camp Rilea now?</b></p> <ul style="list-style-type: none"> <li>Predominant water uses: domestic plumbing is <b>59%</b> of total; kitchen and laundry equipment is <b>22%</b> of total</li> </ul>				
	<p><b>Where is Camp Rilea headed?</b></p> <ul style="list-style-type: none"> <li>Net Zero water objective: Limit the consumption of potable water and return treated water to the local aquifer via infiltration basins in the same quantity that is pumped over the course of a year</li> </ul>				
	<p><b>How will Camp Rilea get there?</b></p> <ul style="list-style-type: none"> <li>Implement LCC-effective WCMs; note that Camp Rilea has already met the core Net Zero water objective by returning the same volume of water as is pumped from the local aquifer</li> </ul>				



Plumbing



Irrigation



Losses



Industrial







# PNNL's Pilot Summaries



Potable Water Use Intensity (gal/sq. ft.): FY07(baseline) FY12(current) FY20(target) FY20(projected)

		124	92	62 <sup>1</sup>	73 <sup>1</sup>
FORT BLISS	<p><b>Where is Fort Bliss now?</b></p> <ul style="list-style-type: none"> <li>• Predominant water uses: irrigation is <b>46%</b> of total; domestic plumbing is <b>18%</b> of total</li> </ul> <p><b>Where is Fort Bliss headed?</b></p> <ul style="list-style-type: none"> <li>• Net Zero water objective: Offset freshwater withdrawals from the Hueco Bolson aquifer by using reclaimed wastewater for a percentage of irrigation needs and implement water conservation measures</li> </ul> <p><b>How will Fort Bliss get there?</b></p> <ul style="list-style-type: none"> <li>• Use reclaimed water for irrigation of the Sunrise and Sunset Golf Courses</li> </ul>				
		115	48	58	16
FORT BUCHANAN	<p><b>Where is Fort Buchanan now?</b></p> <ul style="list-style-type: none"> <li>• Predominant water uses: unknown water uses are <b>43%</b> of total; domestic plumbing is <b>24%</b> of total; distribution system losses are <b>18%</b> of total</li> </ul> <p><b>Where is Fort Buchanan headed?</b></p> <ul style="list-style-type: none"> <li>• Net Zero water objective: Reduce potable water consumption volumetrically by 60% and become a self-sufficient system whereby water is produced and treated on-site and returned to the local aquifer</li> </ul> <p><b>How will Fort Buchanan get there?</b></p> <ul style="list-style-type: none"> <li>• Upgrade the distribution system infrastructure to limit losses; produce potable water and treat wastewater on-site</li> </ul>				



Plumbing



Irrigation



Losses



Industrial







# PNNL's Pilot Summaries



Potable Water Use Intensity (gal/sq. ft.): FY07(baseline) FY12(current) FY20(target) FY20(projected)

					
FORT CARSON		53	55	27	25
		<p><b>Where is Fort Carson now?</b></p> <ul style="list-style-type: none"> <li>• Predominant water uses: irrigation is <b>56%</b> of total; domestic plumbing is <b>27%</b> of total</li> </ul>			
		<p><b>Where is Fort Carson headed?</b></p> <ul style="list-style-type: none"> <li>• Net Zero water objective: Reclaim water through the on-site WWTP equal to or greater than the amount of potable water supplied to the site over the course of a year</li> </ul>			
		<p><b>How will Fort Carson get there?</b></p> <ul style="list-style-type: none"> <li>• Implement direct potable reuse to maximize use of reclaimed wastewater during non-irrigation months</li> </ul>			
FORT RILEY		48	42	24 <sup>1</sup>	32 <sup>1</sup>
		<p><b>Where is Fort Riley now?</b></p> <ul style="list-style-type: none"> <li>• Predominant water uses: domestic plumbing is <b>36%</b> of total; irrigation is <b>10%</b> of total</li> </ul>			
		<p><b>Where is Fort Riley headed?</b></p> <ul style="list-style-type: none"> <li>• Net Zero water objective: Limit the consumption of freshwater resources and return treated wastewater to the Kansas-Lower Republican basin in the same quantity that is withdrawn for potable water production over the course of the year</li> </ul>			
		<p><b>How will Fort Riley get there?</b></p> <ul style="list-style-type: none"> <li>• Implement WCMs and use reclaimed wastewater for irrigation and other non-potable uses in the Custer Hill area</li> </ul>			



Plumbing



Irrigation



Losses





Industrial



# PNNL's Pilot Summaries



Potable Water Use Intensity (gal/sq. ft.): FY07(baseline) FY12(current) FY20(target) FY20(projected)

JOINT BASE LEWIS-MCCHORD		74	60	37 <sup>1</sup>	48 <sup>1</sup>
		<p><b>Where is Joint Base Lewis-McChord now?</b></p> <ul style="list-style-type: none"> <li>• Predominant water uses: domestic plumbing is <b>33%</b> of total; unknown water uses are <b>27%</b> of total</li> </ul> <p><b>Where is Joint Base Lewis-McChord headed?</b></p> <ul style="list-style-type: none"> <li>• Net Zero water objective: Limit the consumption of freshwater resources and reclaim wastewater effluent so that there is no discharge from the WWTP to the Puget Sound</li> </ul> <p><b>How will Joint Base Lewis-McChord get there?</b></p> <ul style="list-style-type: none"> <li>• Implement indirect and direct potable reuse to maximize the use of reclaimed water from the WWTP</li> </ul>			
TOBYHANNA ARMY DEPOT		20	12	10	8
		<p><b>Where is Tobyhanna Army Depot now?</b></p> <ul style="list-style-type: none"> <li>• Predominant water uses: industrial processes is <b>34%</b> of total; domestic plumbing is <b>19%</b> of total</li> </ul> <p><b>Where is Tobyhanna Army Depot headed?</b></p> <ul style="list-style-type: none"> <li>• Net Zero water objective: Limit the consumption of freshwater resources and return treated wastewater to the Hummler Run watershed in the same quantity that is pumped from groundwater wells for potable water production over the course of the year</li> </ul> <p><b>How will Tobyhanna Army Depot get there?</b></p> <ul style="list-style-type: none"> <li>• Utilize reclaimed water for WWTP applications; note that Tobyhanna Army Depot has already met the core Net Zero water objective by returning as much water to the local watershed as is pumped from the local groundwater source</li> </ul>			



Plumbing



Irrigation



Losses



Industrial



# PNNL's Water Balance and Roadmap Report – Example Fort Buchanan



FORT BUCHANAN



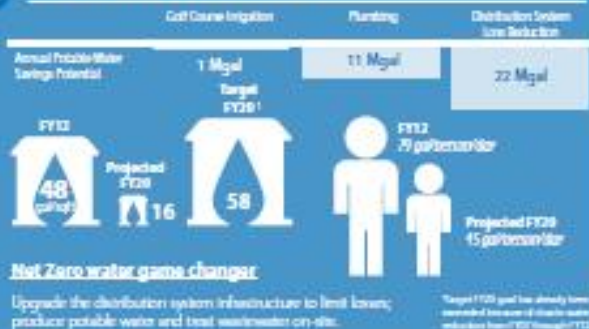
**For Buchanan's Net Zero water objectives:**  
Reduce potable water consumption volumetrically by 60% and become a self-sufficient system whereby water is produced and treated on-site and returned to the local aquifer.

## Fort Buchanan, Puerto Rico QUICK FACTS

16 million sq ft of facility space	24% of water is used in plumbing
76 Mgal FY12 potable water use	18% of water is attributed to system losses
1 Mgal of ILA water used in non-potable golf course irrigation	Fort Buchanan potable water from Puerto Rico Aqueduct and Sewer Authority
	Developing on-site potable wells



## ROADMAP SHORTCUT



## Army Net Zero Water Balance and Roadmap Programmatic Summary

### Fort Buchanan

#### Background

U.S. Army Garrison, Fort Buchanan covers 746 acres in metropolitan San Juan, Puerto Rico. Established in 1923, Fort Buchanan is an Army Reserve site known as the Sentinel of the Caribbean. Currently, Fort Buchanan's potable water is supplied by Puerto Rico Aqueduct and Sewer Authority (PRASA). Fort Buchanan discharges all of its wastewater to PRASA.

Fort Buchanan lies in a vulnerable region for water scarcity considering sedimentation of reservoirs, growing regional population, increasing demand due to climate change, and infrastructure leaks.

#### Water Balance

Fort Buchanan consumes potable water in end-uses such as plumbing fixtures and commercial kitchen equipment in barracks, family housing, schools, and administration buildings across the installation. However, the water balance revealed that the predominant water use at Fort Buchanan is distribution system losses and "unknown" water use (Figure 4.1). Unknown water use is unaccounted for water that cannot be attributed to specific end-uses investigated during the water balance assessment. The high level of unknown water use is likely due to a higher-than-expected loss rate in Fort Buchanan's distribution system and meter inaccuracy. ILA water is consumed at Fort Buchanan in irrigation at the golf course through a recently installed non-potable well. Approximately 1 Mgal is used annually.

#### Roadmap

Through the roadmap process, Fort Buchanan developed a conceptual framework for achieving Net Zero water. This concept transitions Fort Buchanan to a

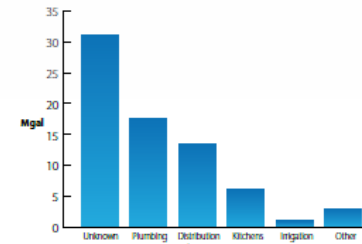


Figure 4.1 Fort Buchanan Annual Water Use Breakout

self-sufficient system whereby the majority of potable and non-potable water will be produced on-site from local groundwater resources and wastewater will be treated on-site and infiltrated back to the groundwater through infiltration basins (Figure 4.2).

To reduce its demand for potable water, Fort Buchanan is implementing several water efficiency projects through its ESPC, including high efficiency plumbing fixtures and rainwater harvesting for flushing toilets and urinals, with a total savings of 10 Mgal annually. Therefore, the roadmap assessment focuses on reducing distribution system losses, which were identified in the water balance.

Three options for distribution system improvements were analyzed as part of the roadmap including 1) replacement of the entire distribution system; 2) annual leak detection surveys and repair; and 3) implementing a continuous leak monitoring program. The first option is a wholesale replacement of the potable water distribution system. Fort Buchanan has documented frequent repairs of the distribution system, indicating that the infrastructure is in disrepair and may need a

<http://www.asaie.army.mil/Public/ES/netzero/docs/NZW%20Programmatic%20Summary-FINAL-10-30-13.pdf>



# PNNL's Water Balance and Roadmap Report – Example Fort Buchanan (cont.)



Army Net Zero Water Balance and Roadmap Programmatic Summary

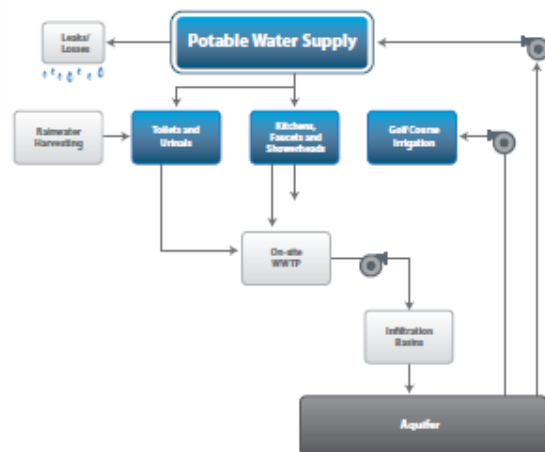


Figure 4.2 Fort Buchanan's Proposed Net Zero Water Concept

comprehensive replacement. In addition to distribution replacement, the roadmap also assessed the less aggressive option of ongoing leak monitoring. Two distinct strategies were investigated: leak detection using conventional leak surveys and leak monitoring using a network of leak noise loggers (LNLs). The conventional leak detection survey uses acoustic equipment to manually listen for leaks at exposed parts of the distribution system. The survey is typically a one-time event providing a snapshot of system leaks. An alternative to conventional leak detection surveys is leak monitoring, which uses a network of LNLs deployed in a grid around a section of the distribution system. The loggers listen for leak sounds at programmed intervals (e.g., at night) and record the sound data. Software analyzes the data to determine whether the LNLs are detecting leaks.

An LCC analysis was performed to provide Fort Buchanan with an economic indicator for the three options (Table 4.1). The analysis found that leak detection is very cost-effective, whereas distribution system replacement is not. A feasibility study of the distribution system will be needed to determine the extent to which line replacement is needed. The study should determine the current condition and identify targeted areas for replacement versus rehabilitation. Note that large infrastructure replacement projects can be funded through military construction funds that do not require the project to be LCC-effective.

As part of the roadmap, a plan was developed to formulate options for Fort Buchanan to achieve the Net Zero water objective, which includes distribution system improvements, efficient plumbing fixtures,

Table 4.1 Distribution System Improvements LCC Analysis Results

Net Zero Water Project	Water Savings (Mgal/yr)	Cost Savings (\$/yr)	Installed Cost (\$)	Simple Payback (yr)	Savings-to-Investment Ratio	Net Present Value (\$)
New Distribution System	21	264,400	11,520,000	62	0.5	-6,081,900
Annual Leak Detection Survey	10	105,200	238,800	N/A	5.3	1,036,600
Leak Monitoring	10	105,200	100,000	2	12.8	1,175,400

rainwater harvesting, and offsetting potable use with non-potable well water for golf course irrigation. These projects achieve an impressive water reduction of approximately 34 Mgal annually through FY 2020 (Figure 4.3).

Fort Buchanan's FY 2007 WUI baseline was 115 gal/sqft. For Buchanan's current WUI is 48 gal/sqft, which is already well ahead of the WUI reduction goal of 58 gal/sqft. If the planned activities and recommended WCMs are implemented, Fort Buchanan will further reduce its WUI to approximately 16 gal/sqft. In addition to meeting the potable WUI reduction goal,

Fort Buchanan should also strive to meet the ILA water reduction goal of 40% by FY 2020, reducing the golf course irrigation from an FY 2013 baseline of 1,060 kgal to less than 636 kgal by FY 2020.

## Roadmap Progress

Fort Buchanan has implemented high efficiency plumbing retrofits installation-wide through its ESPC. In addition, Fort Buchanan has already transitioned from purchased potable water to on-site non-potable groundwater to irrigate the golf course. Pursuing rainwater harvesting for flushing toilets and urinals

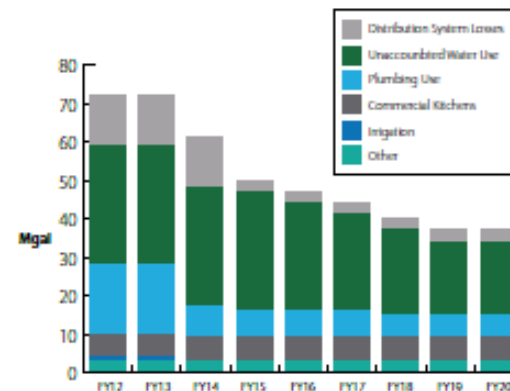


Figure 4.3 Fort Buchanan Projected Water Use

along with potable wells through its ESPC will offset the amount of potable water purchased from PRASA. Fort Buchanan is working with the Army Corps of Engineers to develop a comprehensive hydraulic model of its distribution system to help formulate a strategic plan for reducing losses in the system. Feasibility studies are being conducted to investigate whether a WWTP can be built on-site. The treated water from the WWTP could be sent to rapid infiltration basins to recharge the aquifer.

# Life-Cycle Cost Effectiveness of Water Conservation Measures



- \$ High efficiency faucets and showerheads – very good
- \$ High efficiency toilets and urinals – poor
- \$ Efficient irrigation and native landscaping – marginal to poor
- \$ Industrial process improvements – good
- \$ Leak detection and repair – good to very good
- \$ Efficient kitchen equipment – marginal to good
- \$ Medical and laboratory equipment retrofits – good to very good

**List of  
common water  
conservation  
measures and  
typical life-  
cycle cost  
effectiveness  
as determined  
through  
PNNLs study**





# The Cost of Water



- Low cost of water = Longer time to payback
- Double charged for incoming and outgoing
- Army owned WWTP – true cost of water = water/sewer rates

It may be beneficial to bundle water projects with energy projects to make them more economically appealing.



# Project Implementation Funding Strategies

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- Energy Conservation Investment Program (ECIP)
- Energy Savings Performance Contracts (ESPC)
- Performance-Based Service Contracting (PBSC) for Leak Detection and Repair
- Sustainment, Restoration and Modernization (SRM)
- Utilities Privatization Contract
- Bundle water and energy projects

Saving Water =  
Saving Energy

Additional information can be found on the FEMP Financing Mechanisms website:  
[www.femp.energy.gov/financing/mechanisms.html](http://www.femp.energy.gov/financing/mechanisms.html)



# FEMP's Water Efficiency BMPs



The BMPs developed for E.O. 13423 continue to help Federal agencies achieve the water efficiency goals of E.O. 13514.

- BMP #1 - Water Management Planning
- BMP #2 - Information and Education Programs
- **BMP #3 - Distribution System Audits, Leak**

## **Detection, and Repair**

- BMP #4 - Water-Efficient Landscaping
- BMP #5 - Water-Efficient Irrigation
- BMP #6 - Toilets and Urinals
- BMP #7 - Faucets and Showerheads

<http://energy.gov/eere/femp/federal-water-efficiency-best-management-practices>

[http://www.epa.gov/watersense/commercial/federal\\_agencies.html](http://www.epa.gov/watersense/commercial/federal_agencies.html)





# FEMP's Water Efficiency BMPs Cont



**The BMPs developed for E.O. 13423 continue to help Federal agencies achieve the water efficiency goals of E.O. 13514.**

- BMP #8 - Boiler/Steam Systems
- BMP #9 - Single-Pass Cooling Equipment
- BMP #10 - Cooling Tower Management
- BMP #11 - Commercial Kitchen Equipment
- BMP #12 - Laboratory/Medical Equipment
- BMP #13 - Other Water Intensive Processes
- BMP #14 - Alternate Water Sources

<http://energy.gov/eere/femp/federal-water-efficiency-best-management-practices>

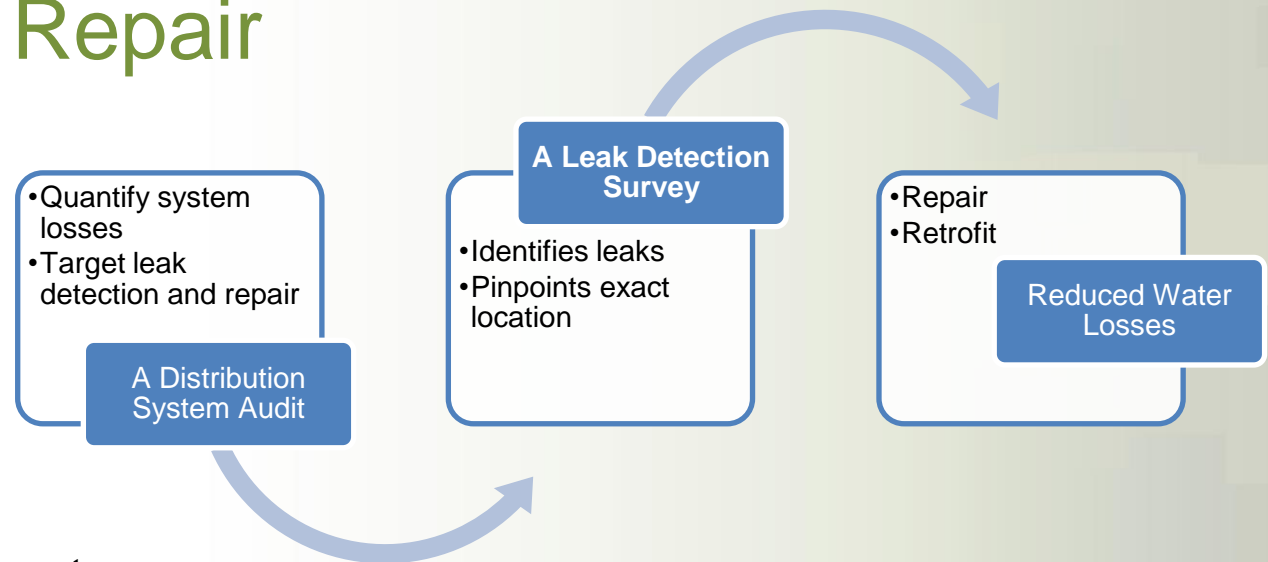
**NEXT SLIDE – A SNAPSHOT OF BMP#3**

[http://www.epa.gov/watersense/commercial/federal\\_agencies.html](http://www.epa.gov/watersense/commercial/federal_agencies.html)



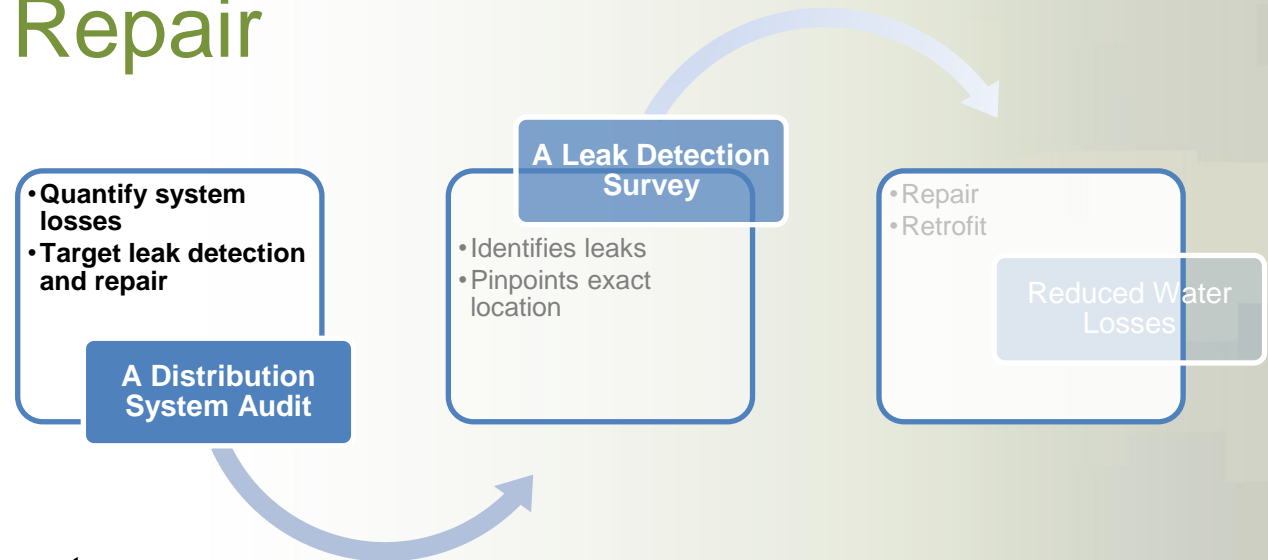
# Snapshot of FEMP's BMP #3

## Distribution, System Audits, Leak Detection, and Repair



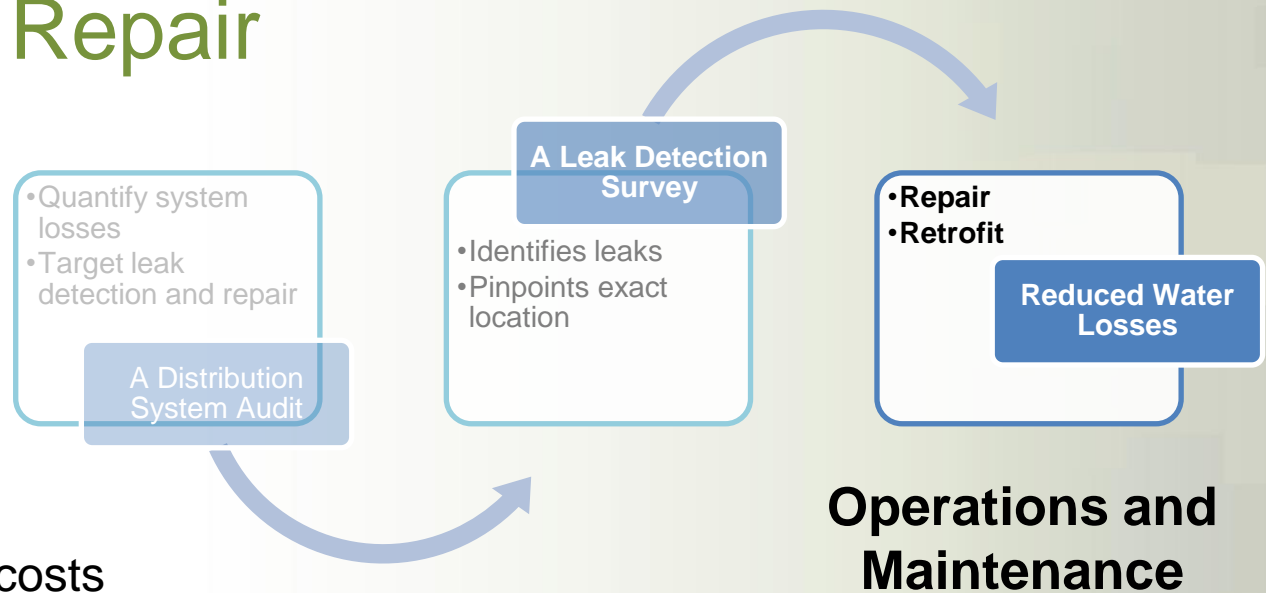
- Reduced water losses
  - Reduced operating costs
  - Increased knowledge of the distribution system
    - Reduced property damage
      - Improved justification for water management

# FEMP's BMP #3 Continued Distribution, System Audits, Leak Detection, and Repair



- Reduced water losses
  - Reduced operating costs
  - Increased knowledge of the distribution system
    - Reduced property damage
    - Improved justification for water management

# FEMP's BMP #3 Continued Distribution, System Audits, Leak Detection, and Repair

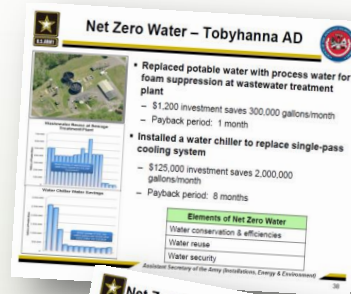


- Reduced water losses
  - Reduced operating costs
  - Increased knowledge of the distribution system
    - Reduced property damage
      - Improved justification for water management

# Internal and External Collaboration



- Share and document lessons learned
- Build cross-functional Net Zero teams
- Assist each other with challenges
- Conduct monthly calls and periodic progress meetings
- Local and regional authorities
- Federal Government
- Public-private partnerships





# Net Zero Water – Fort Riley



## Membrane Bio-reactor Waste Water Treatment Technology

# Sustainable JBLM - the Net Zero Brand



Joint Base Lewis-McChord is committed to supporting a strong national defense, securing the integrity of our natural and cultural heritage, and conserving our natural resources for tomorrow's generations, while seeking choices that enhance our neighboring communities' abilities to have a productive future.



Joint Base Lewis-McChord

The Sustainable JBLM brand connects the Net Zero initiative with the sustainability goals for the installation.





# The Commanders' Pledge



Contest #2

## Commander's Net Zero Pledge

As recognized by the Army Net Zero program, today's fighting force must manage resources to reduce waste and inefficiency. Doing so enhances mission capability and resource security, maximizes budgets and improves relationships with local communities. I, \_\_\_\_\_, Commander of \_\_\_\_\_, therefore commit myself and my unit to uphold the principals of Net Zero Energy, Waste, Land, Air and Water by meeting the following actions:

### Net Zero Energy

- Develop unit energy program
- Appoint personnel to monitor energy consumption
- Perform end-of-day checks

### Net Zero Waste

- Promote recycling and waste reduction
- Comply with sustainable acquisition requirements in procurement practices

### Net Zero Land

- Designate personnel to manage unit actions while in training areas to ensure no unauthorized entry into or damage to a restricted area

### Net Zero Air

- Appoint personnel to monitor the unit Commute Trip Reduction program
- Prevent all illegal open burning

### Net Zero Water

- Establish an individual to monitor water use and water conservation actions
- Promote actions which preserve and protect water resources on JBLM

To meet these actions I will:

- Direct individuals in my organization to receive JBLM's Net Zero training and carry out the actions described herein
- Ensure appointed personnel receive training as described in the award criteria
- Monitor my unit's level of participation with the Net Zero Award program
- Personally communicate the importance of preserving resources in all five areas of Net Zero to personnel under my supervision; I will make this Net Zero pledge my personal responsibility and official duty priority
- Ensure my unit displays Net Zero posters, brochures and special announcements prominently inside all facilities occupied by my organization
- Ensure my unit will engage in this competition fairly and follow the competition rules

Signed: \_\_\_\_\_ Date: \_\_\_\_\_

**Entry into JBLM's semi-annual Net Zero Contest starts with a "Commander's Pledge" that commits units to Net Zero concepts.**

**First prize  
is \$7500!**

**The JBLM NZ Award competition:**

- Promotes sustainability by engaging military units in a friendly competition among peer groups
- Encourages military units to act sustainably
- Inspires military personnel to achieve excellence in resource conservation





# Best Practices – Water



## ■ Maximize the use of xeriscaping

- ❑ Turf irrigation is one of the most common water demands at Army installations
- ❑ Camp Rilea converted turf to native meadows and rain gardens to reduce irrigation needs



**Synthetic Turf Conversion**

## ■ Implement leak detection on the potable water distribution system

- ❑ Tobyhanna implemented an aggressive metering and leak detection program resulting in 38% reduction in water use intensity



**Xeriscape Conversion**



# Best Practices – Water (cont.)



- **Maximize water recycling**

- ☐ Matching water quality to intended use

- **Install purple pipe**

- ☐ Separating reclaimed water via installation of purple pipe system
- ☐ Several pilot developing projects to design, plan, and install

- **Maximize use of alternate water sources**

- ☐ Collect and use rain water for industrial cooling tower
- ☐ Capturing stormwater for use in irrigation



**Vehicle Wash Stations**



**Alternative water source**



# Lesson's Learned



## Defining Net Zero Water



# Lesson's Learned



## Defining Net Zero Water

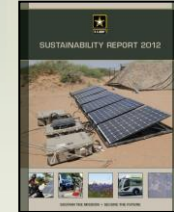


# Questions?



## Army Sustainability Report 2012

<http://usarmy.vo.llnwd.net/e2/c/downloads/269536.pdf>



## Office of the Assistant Secretary of the Army for Installations, Energy and Environment

<http://www.army.mil/asaiee>

## Office of the Deputy Assistant Secretary of the Army, Energy and Sustainability

<http://www.asaie.army.mil/Public/ES/>

## Army Net Zero

<http://www.asaie.army.mil/Public/ES/netzero/index.html>



<http://datacenter.leadgroup.com/sirra/>

<http://acwc.sdp.sirsi.net/client/search/asset/1034140>



## Net Zero Water Module

**Slide 1:** I am Kristine Kingery. I work in the Army Secretariat in the Office of the Assistant Secretary of the Army for Installations, Energy and Environment. I am the Director of Army Sustainability Policy and the Army lead for the Net Zero Installation Initiative. Thank you for tuning in to Session 4 of the Net Zero online training.

**Slide 2:** This is Module #4 –Net Zero Water. This slide lists the topics that will be covered during this session.

First I'll go over the objectives of this training and what will be accomplished – and basically, what you should know by the end of this session.

We'll cover the driving forces behind Net Zero Water: And when we talk about drivers, we're not just talking about the *regulatory drivers* such as the policies, regulations, and goals set forth in Presidential Orders, Congressional Acts, DoD Directives and Strategic Sustainability Performance Plans, or Headquarters Department of the Army policy memorandums, Army Regulations, and associated Plans (for example the Army Campaign Plan). We are also going to look at forces that drive the Net Zero goals including the physical and environmental limitations that are or can potentially be a threat to continuity of operations and missions at Army installations – such as drought and extreme weather events, water scarcity or threats to water security such as contamination or Climate change. The complexities of this other set of drivers – particularly climate change – are outside the focus of this training module, but will be summarized, briefly.

I discussed the Net Zero hierarchy in detail in the 1<sup>st</sup> and 2<sup>nd</sup> module and revisited the Net Zero *Energy* hierarchy in Module #3 – Net Zero Energy. For this session I will revisit the hierarchy, also referred to as an inverted triangle that represents the Army's priority of approaches to Net Zero Water.

We'll 're-review' the Army's Net Zero Pilot Installation Initiative specific to the Net Zero Water Pilots and provide an overview of what these Net Zero Water pilots have accomplished and what we have learned through their activities of three plus years of being a Net Zero Water pilot.

We'll explore the Federal Energy Management Program and EPA's WaterSense Program related to best management practices (BMPs) and take a look at a snapshot at one of them.

And finally, information and guidance will be provided on processes, programs and procedures related to Net Zero Water that have been determined to be a “Best Practice” at Army installations, stellar examples, challenges identified or “Lessons Learned” and potential sources of funding.

Ok now let’s talk about why you’re here.

**Slide 3:** Learning Objectives:

The objective of this training is to present relevant information you can use to support your installation in its pursuit of Net Zero Water.

By the end of this session you should:

1. Understand how the Army’s Net Zero Water Definition supports our efforts to meet and/or exceed mandates, regulations, and goals.
2. Understand how water issues impact Army installations and how managing water resources sustainably is a mission enabler in that it ensures the Army will have the water it needs to train and operate today and in the future.
3. Delve into the concepts, data and resources required to develop a water balance or baseline, develop a plan, and assess water security.
4. Identify the resources available to determine what might work at your installation. Review the basics of funding and contract mechanisms available for implementing energy projects at your installation

Now let’s review what’s driving the Net Zero initiative in terms of regulatory drivers and mission impact drivers. Regulatory drivers motivate actions taken to comply with requirements which are relatively straight-forward and involve tangible numerical metrics. Mission impact drivers motivate actions taken towards Net Zero to mitigate risk to an installation’s mission – usually related to natural disasters potential impact, water security, drought, water scarcity and climate change.

**Slide 4:** Drivers; Regulatory.

This table lists some of the more significant mandates that drive Net Zero Water. I’ll discuss a few of them and pause here to give you a chance to read the table.

Pause

Beginning in the late 1990s the federal government demonstrated their commitment to sustainability – as the Environmental Orders issued during this time addressed waste reduction, recycled content purchasing, and energy efficiency. The Energy Policy Act of 1992 and Executive Order 13123, among others, required that federal agencies address sustainable design **comprehensively**, including energy efficiency, **efficient use of water**, waste reduction, sustainable site planning, and indoor environmental quality.

EO 13123 Greening the Government through Efficient Energy Management required installations to develop water management plans and specifically called for the federal government to step up and lead the way towards improved energy management. The federal agencies did and continue to do so (especially the Army). EO 13123 was the first of its kind and eventually other legislation was enacted that reinforced EO 13123 and took the principles of sustainability further and strengthening water conservation requirements.

Today, EPCA 2005, the Energy Independence and Security Act of 2007, EO 13423, and EO 13514 require Federal agencies to achieve water reduction targets, improve water efficiency and improve water security. This set of legislation, among other requirements, directs Army installations to incorporate best management practices developed and published by the Federal Energy Management Program (FEMP) to help them achieve water efficiency goals. EPA collaborates with FEMP in updating these BMPs through their WaterSense Program to account for the ever-changing requirements, water use patterns and advancing technologies.

EO 13423 Strengthening Federal Environmental, Energy, and Transportation Management and EO 13514 Federal Leadership in Environmental, Energy, and Economic Performance set specific potable water intensity reduction requirements. EO 13514 added requirements for reducing industrial, landscaping, and agricultural (ILA) (nonpotable) water consumption. **The Army continues to be ahead of schedule for potable water intensity reduction. The FY 2013 potable water intensity reduction is 26.6 percent compared to the FY 2007 baseline, which is 14.6 percent ahead of the FY 2013 goal path and already exceeds the FY 2020 goal of a 26 percent reduction.**

Next we'll review Net Zero drivers that stem from threats to mission continuation such as water scarcity and climate change. We'll start with what the 2010 and 2014 Quadrennial Reviews said about climate change



## **Slide 5: Drivers: Climate Change**

The 2010 Quadrennial Defense Review concluded that climate change will affect DoD specifically: (1) it will shape the operating environment, roles, and missions that DoD will undertake; (2) extreme weather events may lead to increased demands for defense support to civil authorities for humanitarian assistance or disaster response both within the United States and outside.

The 2014 QDR reported that climate change poses another significant challenge for the United States and the world at large. As greenhouse gas emissions increase, sea levels are rising, average global temperatures are increasing, and **severe weather patterns are accelerating**. These changes in weather patterns may exacerbate water scarcity and coupled with other global dynamics can potentially devastate homes, land, and infrastructure.

The 2014 QDR brought forth plans to address and “evaluate potential effects of climate change on our missions and operational resiliency, develop and implement adaptation plans, and collaborate with our allies and partners through climate-related initiatives”.

Now I will briefly review research findings from the RAND Corporation’s “Key Trends That Will Shape Army Installations of Tomorrow” 2013 conducted under contract for the Army’s Office of Assistant Chief of Staff for Installation Management (OACSIM) to examine how external trends might affect Army installations out to the year 2025.

## **Slide 6: Climate Change.**

According to the RAND report, Army installations are likely to experience the impacts of climate change such as declining water supply, flooding, increased uncertainty and wider fluctuations in temperatures, changes in habitat, and subsequent changes to the installation training environment. For instance, installations with part of their property along the coastline or at sea level, like Aberdeen Proving Ground, may need to prepare for potential sea level rise. Climate change will also affect the Army's water supply, especially in the southwest and southeast. Installations, such as Fort Huachuca, may need to prepare and plan for extended drought conditions. This, in conjunction with fluctuating temperatures and loss of habitat may cause the loss of natural vegetation, which in turn could affect installations’ training environments.

In 2008, the National Intelligence Council (NIC) indicated that more than 30 U.S. military installations were already facing elevated levels of risk from rising sea levels. The potential impacts of climate change pose a significant threat that could affect DoD's operational readiness and training.

For more information on this topic, I encourage you to read the Construction Engineering Research Laboratory (CERL) and the US Army Engineer Research and Development Center (ERDC) report which presents the results of a study they conducted on the potential effects of climate change and water scarcity at ten (10) Army installations available on the Army Environmental Policy Institute's website <http://www.aepi.army.mil/> *Water Sustainability Assessment for Ten Army Installations*.

We continue this discussion with the next slide that explores how the Army is defining water security and key issues.

### **Slide 7:** Water Security

The "Army Water Security Strategy" also available on the Army Environmental Policy Institute's (AEPI) website is the first study completed on Army water security management and was developed to define water security and identify key issues on which Army leadership should focus to ensure that the Army has enough water of suitable quality for the foreseeable future.

The slide contains the definition of water security and the six key issues that are the conceptual framework for achieving water security

- Sources: Monitoring and protecting the quantity and quality of natural, raw water available to the region in cooperation with state and local officials and with private conservation organizations.
- Supply: Identifying Army's current and future water requirements; working with water suppliers to ensure that shared water resources can meet the needs of the Army and other consumers; sizing Army water systems to meet future demands.
- Sustainable Practices: Implementing sustainable water programs such as Net Zero Water use efficiency concepts and implementing water conservation, recycling, and reuse programs. These practices should be tailored to the specific conditions and capabilities of individual Army installations.
- Survivability: Preventing and recovering from water supply disruption or contamination; preparing water supply contingency plans for droughts or power failures; establishing backup water supply sources and agreements; timely budgeting of Sustainment, Restoration and Modernization (SRM) and Military Construction (MILCON) funds to repair or replace deteriorated water systems.

- Sponsorship: Identification and alignment of Army water management responsibilities; ensuring that specific organizations are assigned clearly-defined roles for managing all aspects of Army water programs including water source protection, planning future water requirements, timely funding of new water projects, defense of Army water rights, physical security and contingency planning, utility privatization and procurement issues, and stakeholder engagement programs.
- Stakeholders: Constructive, ongoing engagement with local, regional, and state-level public and private water stakeholders; promoting collaborative efforts to protect water sources and to use shared water supplies on a sustainable basis; informing public decision makers and regulators of Army's current and future water requirements; working to publicize Army's water requirements.

A key point raised in this document is the importance of “looking beyond water conservation because, although increased water efficiency and conservation measures can reduce the cost of supplying water and contribute to sustaining the regional water supply, those measures cannot replace water that has been contaminated or consumed by other users, or is no longer available due to changes in long-term climate patterns”.

Now that we understand the driving issues, let's revisit the Army Net Zero Pilot Installation Initiative and the Net Zero Hierarchy – with a focus on Net Zero Water.

#### **Slide 8:** Net Zero Pilots:

On 17 February 2011, Ms. Hammack announced and invited all Army commands to nominate installations for potential as an Army Net Zero pilot installation. Commands submitted their nominated installations and supplemental data on 15 March 2014.

We received twenty-three (23) **water** nominations and reviewed using a rigorous process intended to develop recommendations for our Senior Leaders to make the final determination. Criteria for evaluation included:

- Command or installation-level support to pursue a Net Zero status
- Mission Critical Restrictions
- Watershed Vulnerability
- Water Efficiency Program Strength
- Water Right Restrictions
- Utility Privatization Restrictions
- Access to Alternative Water Sources
- Alternative Water Regulatory Restrictions

The following eight (8) Army installations were identified as Net Zero Water pilot sites at the 19 April 2011 Garrison Commander's Conference in San Antonio, TX: Fort Riley Kansas, Camp Rilea Oregon, Fort Buchanan Puerto Rico, Fort Carson Colorado, Joint Base Lewis McChord, (JBLM) Washington, Fort Bliss Texas, Tobyhanna Army Depot Pennsylvania, and Aberdeen Proving Ground Maryland. The Army NET ZERO Pilot Installations Initiative has been a success due in large part to the continued outreach, technical support and educational opportunities provided by the Army NET ZERO team to installations

Through three plus years of working with and gleaning knowledge (lessons learned and best practices) from the Pilot Installations, the Army has a better understanding of what installations need to do to move forward in their journey towards NET ZERO Water. The Net Zero Pilot Installation Initiative allowed the Army to identify best practices and lessons learned that can be used to guide all installations in achieving their Net Zero goals. Capturing lessons learned and incorporating best practices in installation operations and management is a crucial step in institutionalizing Net Zero across the Army enterprise. Net Zero can decrease costs; improve energy and water security and increase operational capabilities and resiliency.

Now we'll discuss the Army Net Zero Water Hierarchy.

#### **Slide 9:** Net Zero Water Hierarchy

This Slide shows the inverted triangle for the Army's Net Zero Water Hierarchy and how Net Zero Water was specifically defined in the 28 January 2014 Army Net Zero Directive.

The Original Net Zero Water Definition was to limit the consumption of freshwater resources and to return water back to the same watershed, so not to deplete the groundwater and surface water resources of that region (in quantity and quality) over the course of a year.

The updated Net Zero Water definition mirrors the revised hierarchy.

The Net Zero Water hierarchy is similar to that of Net Zero Energy. It begins with the reduction of water use from all sources, followed by improved efficiency. Installation decision makers identify the largest water uses and seek to perform the same functions with less water. These efforts are a top priority, as they should have the greatest effect on reducing overall water use.

Next, installations maximize water recycling and reuse to reduce the demand on fresh water sources, protecting surface or groundwater sources for future use. The base shifts from potable water use to non-potable sources as much as possible, and minimizes inter-basin transfers of any type of water.

The final step in the hierarchy is focused on recharging the aquifer. The goal of a Net Zero Water installation is to recharge as much water back into the aquifer as it withdraws.

Spanning all of the water hierarchy steps are “Increased Water Security” and “Awareness/Cultural Change.” We acknowledge that achieving Net Zero energy or water does not ensure energy or water security, and that additional steps must be taken to achieve those goals. We also acknowledge the importance of integrating awareness and culture change into all Net Zero efforts.

**Slide 10:** As discussed in Module 1 Net Zero 101, just as the one hierarchy for all three areas of Net Zero did not adequately apply to all, this definition for Net Zero Water may not necessarily fit with your installation. The geology, hydrology, physical and political boundaries of water sources are very diverse from Installation to installation. Water supply and availability also vary among installations and therefore can make meeting the Army’s exact Net Zero Water definition of “recharging as much water back into the aquifer as it withdraws.” challenging. For this reason, the Net Zero Water pilot installations modified the Army’s Net Zero water definition in a way that makes sense for their installation and still meets or exceeds the Army’s intent to foster sustainable water resource availability for the installation and surrounding community. Modifications were slight – a typical example is shown here on this slide. Note how only one word was changed – ‘same watershed’ to ‘regional watershed’. Also of note this is an example of a definition developed before the official Net Zero Policy was issued.

Efforts are underway to capture these differences and address the Army’s intent for Net Zero Water through the revision of AR 420-1 Chapters 22 and 23 that regulate energy and water management at Army facilities. This will be discussed more in detail and a few examples will be provided later, for now let’s walk through the activities the Army Net Zero Team and pilots have undertaken.

**Slide 11:** Net Zero Implementation: Extensive details were provided in Module 2 of the Army’s Net Zero Implementation Plan and the step-by-step process installations should take in developing an approach to Net Zero. Let’s recap:

The Net Zero management approach is based on four overarching actions: Initiate, Assess, Plan and Implement. These steps have been specifically developed for Army installations as a result of

working with the pilot installations. These major steps are the framework to assist Army installations in striving toward Net Zero and are listed in the circle graphic on this slide. Directly under each step are the sub steps.

First is Step 0 - “Initiate.” This step involves identifying and engaging key stakeholders, gathering baseline data and establishing a baseline so that progress can be measured. In terms of Net Zero water this would involve gathering all the data necessary to complete a water balance study. I will go into more detail later when we discuss water balances.

Second is Step 1 – “Assess” where a more in-depth data gathering and analysis is conducted on the installations’ current resource use, needs of the installations and opportunities that should be considered. These opportunities are listed in order of priority and further evaluated and validated in Step 2 – “Plan”. The Net Zero Water Planning process guides the implementation of actions taken towards Net Zero. Plans, projects and processes that emerge from this step are integrated with other plans and processes at the installation; a separate plan is not produced.

In Step 3 “Implement” the focus is on the various approaches to implementing Net Zero at an Army installation. Throughout this module ‘Net Zero Actions’ as used in recent Army Net Zero written reports and other literature, refers to potential Best Management Practices or BMPs, opportunities or other projects installations evaluate and if proven feasible – are carried through to implementation.

Now we’ll go over Water Balances and Water Plans – formerly referred to as ‘Roadmaps’.

**Slide 12:** The Army contracted with the Department of Energy’s Pacific Northwest National Laboratory (PNNL) to develop a water balance and a roadmap for each of the Net Zero Water Pilot Installations. Results were published October 2013 in the ‘Army Net Zero Water Balance and Roadmap Programmatic Summary’ and provided an overview of the assessments performed at each of the eight Net Zero Water Pilot Installations. This included insight into common practices and lessons learned to improve water efficiency across the Army. A water balance is used to quantify water uses at the end-use level to help target efficiency improvements, whereas the Net Zero Water Plan provides a strategy for the installation to implement a time-phased approach for projects to reach the Net Zero Water reduction goals and site-specific Net Zero Water objective.

**Slide 13:** In order to fully understand an installation’s water use, a water balance study is conducted to compare the total water supplied to the site to the actual water consumed at the equipment and process level. The water balance identifies the largest water consumers and also can identify

problem areas such as high leak rates. Background information is collected on the installations overall water supply, wastewater discharge, and building inventory. This information provides historic installation water use trends and specific trends in water use at the building level. Then a building and process walk-through audit provides information to estimate water use at the end-use level. This data is used to provide an estimate of water use by major end-use category. As shown on this slide, a water balance assessment process follows a series of steps:

1. Compile and analyze data from the site to understand use patterns and trends in water use, population, and building inventory. Identify high priority buildings on which to perform walk-through audits during site visits.
2. Perform walk-through audits and interviews with representatives of facilities identified as high priority, this includes water supplied for uses not associated with a building such as irrigation and landscaping for golf courses and parks; in the pilots, these audits accounted for a combined 20 million square feet of facility space.

**Slide 14** (Water Balance Continued)

3. Quantify water use at the end-use level based on information gathered during the walk-through audits. Critical data points include:
  - Annual occupancy data for military, family housing, civilian, and contractors. This information can usually be obtained from the PAIO or the Plans, Analysis and Integration Office.
  - Barracks – Barracks Utilization Report
  - Morale, Welfare, and Recreation (MWR) – number of visitors, data on pools, other water intensive activities
  - Dining – number of daily meals served, annual operating days. This information can be obtained from the installations Directorate of Logistics.
  - Hospital – number of beds, occupancy rate, equipment list, central plant logs
  - Motor Pools and car washes – water usage for central military vehicle wash stations and commercial car washes
4. Extrapolate data to building stock using the installation water distribution system maps. If appropriate request the maps have overlays of water meter locations, irrigation system, retention ponds, storm-water features and central plant distribution. Additionally, in order to estimate irrigation water usage it is helpful to identify drought resistant areas.

5. Evaluate end-use data to determine estimated water use
6. Compare end-use water consumption to the total water supplied to the installation to determine losses and unknown water use.

**Slide 15:** This slide shows one example of a water balance depicted as a flow diagram of Tobyhanna Army Depot's Potable water distribution system. Also shown is annual water usage broken down by major uses.

The water balance can be an important benchmark for Net Zero because it provides information on where water is being used, how much water is being used to perform the installation's mission, and, what technologies and practices have worked well to reduce potable water use.

The results of this water balance will be used to prioritize efficiency improvements to help reduce water use at Tobyhanna Army Depot. Water efficiency measures will be included in the next phase, the Net Zero Water roadmap. The roadmap will provide each Net Zero Water installation a list of prioritized projects that will be used to help form a framework for implementation strategy to meet Net Zero Water goals.

The next slide shows the process used for developing a Net Zero Water plan or roadmap using the insights gained from a water balance.

**Slide 16:** The Roadmap or Planning Process

Ideally, a Net Zero Water roadmap or plan builds a strategic framework from which an installation can identify and implement initiatives to help drive them towards Net Zero. The roadmap will contain specific projects, sequenced over several fiscal years, with the progress that each project will make towards Net Zero clearly identified. An important aspect in most of the steps of this process is collaboration with affected stakeholders and/or support agencies.

Based on results from a water balance, Net Zero water projects will be identified that will have the greatest effect on overall water demand reduction and will move the installation towards Net Zero. Stakeholder engagement at this point is critical to appropriately characterize water project opportunities.

**Slide 17:** Based on the major water uses, water conservation measures (WCMs) are identified and a life-cycle cost (LCC) analysis is performed for each. The LCC results are used to develop an



implementation strategy, including identification of possible funding sources and project phasing to help the installation meet its Net Zero water goals in the identified timeframe. In addition to Water Conservation Measures, the plan (roadmap) process should assess alternative water sources such as reclaimed wastewater that can be used to offset the use of surface and groundwater resources

Projects may include a mix of efficient technologies and projects that target alternate water sources that will replace the use of freshwater resources. As depicted in the Net Zero Hierarchy, there will be an emphasis on demand reduction first, and then alternate water projects. The installations master planning activities will be part of the formulation of the roadmap so that the installation's current plans are well integrated into the Net Zero process.

**Slide 187:** As part of the planning (road mapping) process, stakeholders should be engaged in the decision-making process. Workshops can be used to have attendees score and rank each WCM. This slide shows the Project Prioritization Roadmap Workshop Score Sheet that was used at Camp Rilea during the roadmap workshop where attendees developed a prioritization of the water conservation measures that were developed as part of the Camp Rilea water assessment. The prioritization process essentially scored each project based on the following criteria:

- Water supply and consumption effects
- Mission risk reduction
- Cost implications
- Implementation risk

Multiple questions were asked under each criterion. Each participant scored each question using a scale from 0 to 10.

This and the next slide are examples of what pilot installations can and have done using available tools with contract support.

**Slide 19:** The NDCEE also developed a 'scoring sheet' as shown on this slide. This decision evaluation matrix is available to assist installations when planning Net Zero actions. It is built in Microsoft® Excel for ease of use. The installation first leverages previously completed assessments and makes an integrated list of Net Zero Actions (or NZA's as previously discussed). NZA's can be any activity, project, plan or policy taken to move towards an installation's Net Zero goals. The following evaluation criteria were developed and available as a starting point: Impact on Net Zero Water; Impact on Mission Security; First Cost; Pay Back; Savings to Investment Ratio; Years to

Realized Net Zero Impact; Critical Predecessor; and Feasibility of Implementation Success. Scores can be assigned using standardized ranges and a scale of 1-5 (larger number is better). Drop-down menus within the spreadsheet enable easy, standardized data entry. Sorting and filtering functions within the spreadsheet enable NZA's to be evaluated along any of the individual criteria, by action type, by the impact criteria only or by the financial criteria only.

The next slide shows an example roadmap, now called a plan, prepared for Camp Rilea.

**Slide 20:** This chart represents an aggressive scenario based on Camp Rilea implementing the Water Conservation Measures as suggested in their Roadmap report. Expected results following implementation of water conservation, recycling, and reuse measures are shown here. However, management, procedural, and policy changes, including education and outreach activities, are also considered high priority measures for implementation to encourage water conservation and efficiency.

As such Camp Rilea will arrive at 4.7 Mgal total potable water demand by the year 2020.

This will require an analysis of water quality needs for each type of water use and investigate opportunities that meet the requirements of that activity but do not use potable water.

**Slide 21:** This slide and the next three show a summary of each pilot site from the PNNL report in terms of potable water use intensity and the installations current status, how far they need to go to reach their goals and how they will get there.

As previously discussed – it is important to note that each Net Zero water pilot installation's goals are slightly different as meeting the exact Army definition of a Net Zero water installation is impractical if not impossible in some instances. This is especially true in regards to '*recharging as much water back to the aquifer as is withdrawn*', simply because some installations for 1) do not withdraw water from an aquifer or 2) certain circumstances make it impossible to return or recharge water back to the aquifer. For example, some of the pilot sites purchase water from local suppliers that obtain water from multiple sources. In these cases, the installation developed a site-specific objective in addition to striving to reduce water use intensity (WUI), measured in gallons per square foot (gal/sq.ft.), by 50% from fiscal year (FY) 2007 to FY 2020 and reduce industrial, landscaping, and agricultural (ILA) water use by 40% from FY 2010 to FY 2020. Each of the Net Zero Water pilot's modified definition meets or exceeds the Army's intent which is to foster sustainable water resource availability for the installation and surrounding community.

For each of the following summaries I will cite one of the installation specific Net Zero Water definitions. I will also pause after each to give you a chance to read the Net Zero status reported for each Net Zero Water installation.

We start with the **Aberdeen Proving Ground's Net Zero water objective**: Pursue water efficiency projects and alternative water resources to achieve a 26% reduction of potable water use by FY 2015 and a 52% reduction by FY 2020.

**Slide 22**: **For Buchanan's Net Zero Water objective**: Reduce potable water consumption volumetrically by 60% and become a self-sufficient system whereby water is produced and treated on-site and returned to the local aquifer. [Pause]

**Slide 23**: **Fort Carson's Net Zero Water objective**: By FY 2020 Fort Carson will reclaim water through the on-site wastewater treatment plant equal to or greater than the amount of potable water that is supplied to the site over the course of the year. [Pause]

**Slide 24**: **Joint Base Lewis-McChord's Net Zero Water objective**: Limit the consumption of freshwater resources and reclaim wastewater effluent so that there is no discharge from the Waste Water Treatment Plant to the Puget Sound. [Pause]

**Slide 25**: This slide and the next contains one example from the report: Fort Buchanan which shows "quick facts" about the installation such as water use, facility space, and major water uses, and then provides a 'roadmap shortcut' that highlights important roadmap results, including water savings potential, water use intensity metrics, and key recommended water conservation measures. See the next slide for the other half of this example.

**Slide 26** The report provides background information, results of the water balance assessments, and life-cycle cost analyses on potential water conservation measures and recommendations of how the installation can get to Net Zero

**Slide 27**: The Life Cycle Cost analysis identifies the cost effectiveness of each water conservation measure, both individually and as part of a larger bundled project. Water conservation measures are deemed Lifecycle Cost-effective when they have a savings-to-investment ratio (SIR) of greater than 1. This ratio determines the "break-even" point of the project's cost. Therefore, a project is Lifecycle Cost-effective when the total savings stream is greater than the initial water conservation measure cost. The Lifecycle Cost results were used to develop an implementation strategy for each site,

including identification of possible funding sources and project phasing to help the installation meet its Net Zero goals.

### **Slide 28:** The Cost of Water

Where water is undervalued (as low as two dollars per kiloGallon), it may be difficult to justify efficiency projects. Conversely, the higher the cost of water at an installation, the higher the Return on Investment and fewer years to payback. Installations are often charged twice per KiloGallon of water used, once for water use (water rate) and once for contribution to sewer (sewer rate). This should be factored in when conducting financial analyses on the proposed Net Zero Water project. By the same token, if an installation operates their own wastewater treatment plant (WWTP) they should consider combining the water and sewer rate (\$/Kgal) to evaluate the true cost of water.

Installations increase their chances to fund their Net Zero Water project if they can show cost savings, efficiencies in both water and energy and positive mission impact. The next slide provides examples of potential funding strategies.

### **Slide 29:** Funding Strategies

The Energy Conservation Investment Program is designated for projects that save energy or reduce energy costs. Funding is awarded by the Office of the Deputy Under Secretary of Defense (OSD) on a by-project basis and awards are allocated based on a combination of the highest savings to investment ratio (SIR) and the priorities emphasized by the Energy Policy Act of 2005, Executive Order (EO) 13423, and the Energy Independence and Security Act of 2007. This funding is an important existing program that can be leveraged in support of Net Zero Water as saving water also saves energy. An installation has leveraged ECIP funds to reuse non-potable water for irrigation.

Energy Savings Performance Contracts – Through the ESPC, installations can partner with an Energy Services Company (ESCO) wherein the Company conducts an energy audit and then identifies and implements energy savings improvements with no up-front costs required by the installations. Payment to the ESCO is based on the energy savings over time. Existing ESPCs may be used for water conservation projects, **as saving water also saves energy**. Installations have used ESPCs for water fixture replacements to water conserving fixtures; aerators, showers, and kitchen prep sink.

Using a performance contract for leak detection and repairs is a technique that can leverage existing contracting capabilities. The contract is set up that payment is made only for those leaks detected and fixed, not just the service of detecting leaks. This incentivizes the contractor for repair projects, not just leak detection, improving the overall efficiency of leak detection and repair. Other Performance-Based Service Contracting (PBSC) may be leveraged to improve contractor performance toward Net Zero goals.

Sustainment, Restoration and Modernization (SRM) funds are applied annually to update and improve existing infrastructure through projects developed and prioritized by the installation DPW. These funds should be leveraged for water conservation and efficiency improvements.

Many of the Army water systems have been privatized. It is critical to include water conservation and efficiency outcomes in the privatization contract, properly motivating the contractor to enable Net Zero Water progress. If the contract is just written to cover quality and quantity of water delivered, then the contractor does not have responsibility to reduce overall water use – in fact the incentives may be to do the opposite.

It may be beneficial to bundle water projects with energy projects to make them more economically appealing.

We will now review the resources available to Army installations such as the Best Management Practices (BMP)s developed and published by Federal Energy Management Program FEMP and later transitioned over to EPA's WaterSense program

**Slide 30: FEMP and WaterSense BMPs.** This slide shows 1-7 of the Federal Energy Management Program (FEMP) and EPA's WaterSense program's 14 Best Management Practices.

These BMPs can help installations reduce water use in their operations.

**Slide 31:** FEMP BMPs 8 – 14

I will pause here to give you a chance to review these BMPs and jot down the website address where these can be found.

I will now detail one of the BMPs # 3 Distribution system audit, leak detection, and repair.

Of all the training topics in this session, this is one that should be (and is) presented with great detail.

Distribution system audit, leak detection, and repair programs help Federal facilities reduce water losses and make better use of limited water resources

**Slide 32:** FEMP BMP #3

**Overview**

Federal facilities with large campus settings and expansive distribution systems can lose a significant amount of total water production and purchases to system leaks. Leaks in distribution systems are caused by a number of factors, including pipe corrosion, high system pressure, construction disturbances, frost damage, damaged joints, and ground shifting and settling. Regular distribution system leak detection surveys can generate substantial benefits including:

Reduced water losses: Reducing water losses stretch existing supplies to meet increasing demand. This could defer the construction of new water facilities such as wells, reservoirs, or treatment plants.

Reduced operating costs: Repairing leaks saves money by reducing power costs to deliver water and chemical costs to treat water.

Increased knowledge of the distribution system: Becoming more familiar with the system, including knowing the location of mains and valves empowers personnel to respond faster to emergencies such as main breaks.

Reduced property damage: Repairing system leaks prevents damage to property and safeguards public health and safety.

Improved justification for water management: Conducting routine water audits and verifying production and end point meters results in better accounting and helps validate the need to reduce water losses.

A distribution system audit helps to quantify system losses and target leak detection and repair. A leak detection survey then identifies leak locations, pinpointing the exact location so the leak can be repaired.

**Slide 33:** BMP #3 continued

**Distribution System Audit**

Federal installations should first complete a prescreening system audit. A prescreening audit is a preliminary estimate of losses in the system by quantifying verifiable uses in the system compared to the total supply coming into the installation. The prescreening audit helps determine the need for a full-scale system audit. The following two methods can be used (recommended every two years):

Determine total water supply into the system over a given timeframe.

Quantify all sub-metered uses over this same timeframe. Sub-metered uses may include buildings, reimbursable accounts, and family housing.

Estimate unmetered uses over this timeframe. Unmetered uses may include irrigation, construction, fire suppression, and street cleaning.

Add all verifiable uses (in step 2 and 3) and divide this number by total supply into the system.

If this quantity is less than 0.9, a full-scale distribution system audit is needed. or

Monitor minimum system flow. Perform this during unoccupied periods where flow is at the lowest level, which is typically around 3:00 a.m. or 4:00 a.m.

If there are significant increases to the minimum system flow, it can be assumed leak related and indicates that a full-scale distribution system audit is necessary.

When indicated, facilities should complete full-scale distribution system water audits. A full-scale audit is an in-depth analysis of the distribution system that includes the steps in the prescreening audit with additional steps such as mapping the distribution system, verifying accuracy of meters, and testing distribution controls and operating procedures. A full-scale audit will provide detailed data on system uses that can help quantify losses in the system. The results of the full-scale audit can help direct and prioritize the leak detection efforts.

We will continue with BMP #3 on the next slide under the category of Operations and Maintenance.

### **Slide 34: Best Management Practice #3:**

#### **Operations and Maintenance**

The following operations and maintenance (O&M) options help Federal installations minimize leaks in a distribution system:

Manage pressure in the system to ensure that optimal levels are maintained. High pressure causes wear and tear on the system causing new leaks and increasing loss rates.

Install meters in different areas or zones of the system to monitor flow rates. Manage metered data by setting flow rate thresholds. When exceeded, indicate possible system leaks. Institute cathodic protection for material in the system composed of metal such as pipes and tanks. Cathodic protection controls corrosion of metal surfaces by supplying an electrical current that stops the corrosive reactions.

## **Retrofit and Replacement Options**

The following retrofit and replacement options focus on leak repair and pipe replacement:

Use leak detection devices, such as acoustic or sound-based technology that identifies leaks for repair. Water escaping from pipes creates a distinct sound that moves through the piping material. Different pipe materials transmit different frequency sound at differing lengths. There is a variety of acoustic technologies for different pipe types.

Consider installing permanent detection systems on large distribution systems that monitor for leaks 24/7 to focus leak repair efforts. Permanent systems should be used in conjunction with other leak detection techniques that pinpoint leak locations.

Pinpoint leaks by using a correlator and ground microphone that can determine the exact location of the leak. Tobyhanna has had great success with this type of somewhat new technology.

Repair leaks or replace pipes when leaks are identified. The water savings is astronomical if there are substantial leaks.

For specifics, consult with experts in the field. The first resource should be local or headquarters engineers, but do not overlook input from experienced contractors or other agencies.

### **Slide 35:** Collaboration

One of the most significant best practices is collaboration – which is the cornerstone of the Army's Net Zero Pilot installation Initiative.

The Net Zero team at the Headquarters-level initiated monthly collaboration calls and periodic progress meetings with representatives from the water pilot installations and their Commands.



The Army hosts monthly Net Zero coordination calls with installations and other stakeholders to share challenges and successes they experience through their journey to Net Zero.

Based on a 2011 MOU, the Army is leveraging the Environmental Protection Agency's (EPA) Office of Research and Development to evaluate cutting edge technologies.

The EPA is helping us:

- Increase efficiency and recovery of energy, water, and materials;
- Incorporate design and use of green infrastructure;
- Addresses social/behavioral components of culture,
- Aid in our understanding of water, energy, and material flows and interactions;
- Incorporate water and energy security, and climate-ready solutions; and
- Include the communities as partners in our effort to change the way that we have traditionally managed these critical resources – so that communities are part of the process and can take ownership of solutions.

**Slide 36:**

At Fort Riley, Kansas, EPA scientists and engineers are working with the Army, the Department of Energy's Pacific Northwest National Laboratory (PNNL), U.S. Army Corps of Engineers (USACE), EPA, U.S. Geological Survey's Kansas State University Partnership, and other partners to identify and test a variety of technologies and innovations.

Under this truly cross agency partnership, there are currently three research projects being conducted at Fort. Riley including:

**Water Reuse:** Decentralized treatment systems will be installed and tested by EPA scientists and engineers. First, EPA will test commercially available aerobic membrane bioreactor (MBR) water treatment and store recycled water local non-drinkable reuse at a scale of about 5,000 gallons per day. Second, EPA will test a more advanced anaerobic membrane bioreactor (AnMBR).

**Containment and Control of Contaminated Wastewater:** Fort. Riley uses mostly recycled water and some potable water in a central vehicle wash facility to clean military vehicles. Water from this facility could be treated and reused elsewhere on the installation; however, a military vehicle might become contaminated with a chemical, biological or radiological (CBR) warfare agent in the field. This project will test ways, using harmless surrogates introduced into the wash water as substitutes

for CBR agents. The dirty water which flows off of vehicles might contain oil, grease, metals, and mixtures of suspended solids like dirt and mud. This study is important because the presence of more organic/inorganic materials in water can affect the inactivation of these CBR agents. Data resulting from this study will then be available to other DoD facilities, cities, states, or other agencies that may have to treat large volumes of contaminated water.

**Outreach and Water Conservation:** This project addresses the social drivers of water demand and the effectiveness of water conservation education and outreach. The project will engage, educate, and empower the community living and working at Fort Riley to conserve water resources at the installation, and measure the effectiveness of these efforts. In working with EPA on this project, Fort Riley has become an EPA WaterSense partner - the first Army installation and has full access to tools and educational materials to meet the needs of the community.

Now let's discuss a stellar example of Net Zero – Joint Based Lewis McChord.

**Slide 37:** Sustainable JBLM the Net Zero Brand. Joint Base Lewis-McChord is committed to improving efficiencies, educating their leaders, Soldiers and Airmen, civilians, and family members on Net Zero concepts, demonstrating its benefits, and publicizing how it is a force multiplier. JBLM recognizes that doing so enhances mission capability and resource security, maximizes budgets and improves relationships with local communities. JBLM promotes outreach activity that engages the installation community in Net Zero – they've established a brand now recognized as Net Zero and Sustainability and rally their troops around the Net Zero concept through contests that get the most important people on installation thinking about sustainability – the soldiers.

The Sustainable JBLM brand has been evolving since the inception of the program in 2002, the most recent evolution occurring with the introduction of the Net Zero program. To incorporate the Net Zero initiatives while preserving the sustainability identity, the current Sustainable JBLM brand was created by the JBLM Directorate of Family and Morale, Welfare and Recreation (DFMWR) marketing department with input from the Sustainability Team. The brand includes an overall logo for Sustainable JBLM and individual logos to represent each of the Net Zeroes. A style guide was created so the brand could be used consistently by each of the sustainability teams. The brand is used in all marketing materials and can be seen in various locations around the base. Because of its consistent use, brand recognition is occurring.

**Slide 38:** The Commanders Pledge.

The semi-annual Net Zero Competition provides a monetary incentive for personnel on JBLM to exhibit more sustainable behaviors—actions that will help save money, protect training lands, and enhance air and water quality in the JBLM community. In addition, it also ensures that the military of tomorrow has the same access to energy, water, air, land and natural resources as we do today. By conserving water, JBLM saves the cost to pump, treat, and distribute that water while also realizing savings through reduced flow to the wastewater treatment plant.

Entry into the competition starts with submitting a signed copy of the “Commanders Pledge” as shown on this slide. To compete, Units should conserve water and reduce wastewater generation whenever possible. This includes the following actions:

- Check water sources to ensure taps are closed when not in use, not leaking and that pollutant materials are not allowed to enter storm and sewer drains
- Employ conservation measures that comply with the JBLM water program
- Follow JBLM’s landscape irrigation rules and water only in pride areas
- Ensure hazardous spills do not enter wastewater or storm drains. Such spills will potentially cause pollution in waterways and possible permit violations.

Units that go above and beyond the contest rules can enter their accomplishments in the ‘Initiatives and Innovations’ section of the contest enrollment form.

The Net Zero competition is getting Service members to incorporate sustainability into their day-to-day missions. It also provides a way to reward units for demonstrating sustainable actions.

Now let’s look at Best Practices identified at the eight pilot installations.

### **Slide 39:**

Turf irrigation is one of the most common water demands at Army installations, which is why maximizing the use of Xeriscaping is an important best practice. Camp Rilea, one of the Army National Guard training centers, converted turf to native meadows and rain gardens to reduce irrigation needs. Fort Riley replaced the turf on the fairways at their golf course with a drought-resistant grass – Zoysia. This effort saves the installation 12 million gallons of water annually.

Another key best practice is surveying for leaks and implementing leak detection sensors on the potable water distribution system, as detailed in previous slides – remember FEMP BMP #3?

Tobyhanna Army Depot in Pennsylvania completed an acoustic leak detection survey which resulted

in the identification of six system leaks that were responsible for a loss of approximately 90,000 gallons of water per day. As a result, 54 leak detection sensors were strategically placed throughout the installation by magnetically attaching them to water main valve stems. The sensors check sound levels each day, and the results of the tests are reviewed each month for evidence of leaks by in-house personnel. Tobyhanna continues to lead the way in Net Zero Water and has already surpassed the DoD's goal of 26% potable water use reduction by FY2015 and is well on its way to meeting the 50% reduction goal by FY2020. Additionally, they've installed three water pressure sensors that can provide **real-time notification of major system breaks or leaks**. They plan to install additional monitors (at a cost of fifteen hundred dollars each) as funding allows.

**Slide 40:** Maximizing Water Recycling can be accomplished in many ways. A key is to match the water quality to its intended end use. Using potable water for irrigation, industrial purposes, or vehicle wash racks is not the best match of water quality with end use. Non-potable water can be used for some of these purposes, saving the freshwater resource while also reducing treatment costs.

The use of reclaimed water relies on the installation of a purple pipe system to visually distinguish it from potable. Several of the pilot installations are developing projects to increase the use of treated wastewater.

- Fort Bliss (through the El Paso Water Utility),
- Joint Base Lewis-McChord (through a new Wastewater treatment plant that is currently being designed), and
- Aberdeen Proving Ground (through its groundwater remediation treatment plant).

Water of lower quality – such as rainwater or brackish water – should be used to the maximum extent possible in order to reduce the volume of fresh water resources being contaminated with low concentrations of dissolved salts or other solids. Fort Buchanan has a proposed ESPC project to implement rainwater harvesting on nine buildings and use the water for restroom toilet flushing. Tobyhanna Army Depot is proposing to collect and use rainwater for an industrial cooling tower.

Several other Army installations have become leaders in water conservation efforts. For instance, over the past 15 years, Fort Huachuca has reduced groundwater pumping by 60 percent through projects such as installing artificial turf on physical training fields, introducing waterless urinals, installing water-efficient irrigation, and exploiting rainwater for irrigation of grassy areas. Fort Bragg

has reduced its average daily water consumption by four to five million gallons from 2002 to 2010. This reduction was obtained through measures such as the installation of low-flow toilets and showerheads in buildings. In addition, an odd-even watering schedule was adopted for outside watering, since usage peaks during summer months.

Now let's talk about lessons learned

#### **Slide 41:** Lessons Learned

As previously discussed in the Net Zero Energy Training Module #3 - at the onset of the Net Zero Pilot Initiative we had already collected quite a few lessons learned of which could be categorized into Integration, Technology, Resources (funding and data) and Support. With some modification, the same can be applied to Net Zero Water – with an added sub-category of Defining Net Zero Water.

#### Knowledge of the Water Team

- As discussed throughout this module – the Army's definition of Net Zero Water does not fit some installations. Modifications that are in line with the Army's intent must be made.
- Only a highly skilled NZ Water Program Manager will know "how low is too low". This is in reference to installations that successfully reduced their water usage to a level that impedes flow of biosolids.
- Net Zero Water implementers and teams need appropriate training and skills. In addition, they should recognize and utilize all the available resources they will need to successfully implement projects.

#### Support

- Net Zero must have Command support
- While driven by goals and mandates, the spirit of competition has been more powerful
- Behavior/culture change is needed in addition to technology
- Outreach and education is critical when planning the re-use of water

#### Technology

- Many installations are interested in Purple Piping – which will enable to further water reuse
- Rain harvesting - check your states regulations on this as one installation backed out of their plan to implement this due to new legislation

#### Integration

- Nexus with Water and Waste – All projects must account for tradeoffs between water, energy, and waste
- Integration within existing installation management is key
- Construction/ renovation designs need to change to sync with net zero goals
- Focus on integrated planning is key

#### **Slide 42** Lesson's learned Continued

- Water Security
- Net Zero does not equal water security
- Steps need to be taken to fully address climate change, water scarcity and other factors affecting water security

#### **Resources – Funding or Data**

- Net Zero is an Initiative – a management philosophy; it does not have a separate funding stream.
- Low cost of water makes projects difficult at many installations to prove cost-effectiveness.
- Data Collection
- Without good data the quality of assessments decreases – good data increases the likelihood of identifying leaks
- Metering is key to understanding the water balance and measuring progress

#### **Planning**

- Advanced planning for water projects and incorporating water conservation as a primary consideration in designs are critical to the success of implementing the Net Zero water principles.
- Maintaining flexibility in pursuit of finding the right procurement approach for each project dramatically increases the likelihood of success. This flexibility might include packaging up water with an energy project.

#### **Slide 43:**

Thank you for tuning into Module 4 of the Net Zero online training Net Zero Water The next module will cover Net Zero Waste

Additional information on Net Zero and other Army energy and sustainability programs and policies is available on our office website.

Thank you for your attention.

## **APPENDIX E**

### **Net Zero Training Module 5 Net Zero Waste**



Appendix E NZ  
Training Module 5 Wa



Appendix E NZ Waste  
Module 5 Speaker Not

## **Appendix E**

***Task 0818, "Army Net Zero Prove Out  
Final Net Zero Training Report***





# Army *Net Zero*

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## Army Net Zero Training Module 5: Net Zero Waste

Assistant Secretary of the Army  
(Installations, Energy and  
Environment)



# Module 5 – Net Zero Waste



- Learning Objectives
- Driving Forces Behind Net Zero Waste
  - Regulatory
  - Threats to Continued Mission
- Net Zero Hierarchy
- Pilot Activities
- Stellar Examples and Success Stories
- Best Practices



# Learning Objectives



1. Review the Army definition of Net Zero Waste and the driving forces behind striving towards Net Zero Waste in the Army.
2. Explore how waste issues (such as land use and cost) impact Army installations.
3. Understand the concepts, data and resources required to develop a waste stream analysis, reduce waste sources, and divert waste from landfill disposal.
4. Identify resources available to help plan for and implement Net Zero waste projects.



# Net Zero Waste Drivers - Regulatory

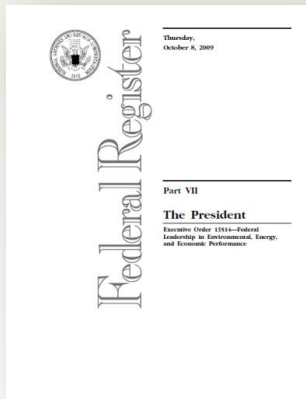


Federal Mandate	Focus Area	Target/Goal
Executive Order 13423	Source Reduction	<ul style="list-style-type: none"> <li>Use sustainable environmental practices in the acquisition of goods and services</li> <li>Use at least 30% post-consumer fiber content paper.</li> </ul>
	Waste Diversion	<ul style="list-style-type: none"> <li>Maintain cost effective waste prevention and recycling programs.</li> <li>Implement policies to extend the useful life of electronic equipment</li> <li>Uses environmentally sound practices with in disposition of agency electronic equipment</li> </ul>
DoD Installation Solid Waste Management (ISWM) Policy and Army ISWM Policy	Source Reduction and Waste Diversion	<ul style="list-style-type: none"> <li>Maintain waste prevention and recycling programs in the most cost-effective manner possible and setting solid waste diversion goals</li> <li>Divert at least 40% of non-hazardous solid waste, excluding (C&amp;D) waste, by FY10.</li> <li>Divert at least 50% of C&amp;D waste by FY15</li> </ul>
Executive Order 13514	Source Reduction	<ul style="list-style-type: none"> <li>Reduce printing paper use and use paper containing at least 30% postconsumer fiber</li> <li>95% of contracts for goods and services to be conducted sustainably</li> <li>Implement policies to enable duplex printing, and other environmentally preferable features on all eligible electronic products.</li> </ul>
	Waste Diversion	<ul style="list-style-type: none"> <li>Divert at least 50% of non-hazardous solid waste, excluding construction and demolition (C&amp;D) waste, by FY15.</li> <li>Divert at least 50% of C&amp;D waste by FY15</li> <li>Increasing diversion of compostable and organic material from the waste stream.</li> </ul>
	Set Goals and Report on Progress	Prepare and submit an annual Strategic Sustainability Performance Plan (SSPP)

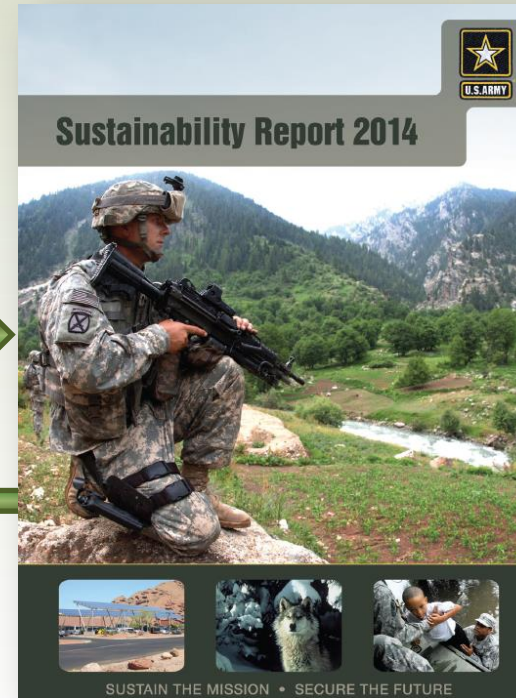
# Goal Setting and Progress Reporting



**EO 13514: Federal agencies must prepare an annual Strategic Sustainability Performance Plan (SSPP)**



**OSD prepares and issues the DoD SSPP**



**The Army provides annual progress to OSD for inclusion in the DoD SSPP and publishes the Army Sustainability Report**

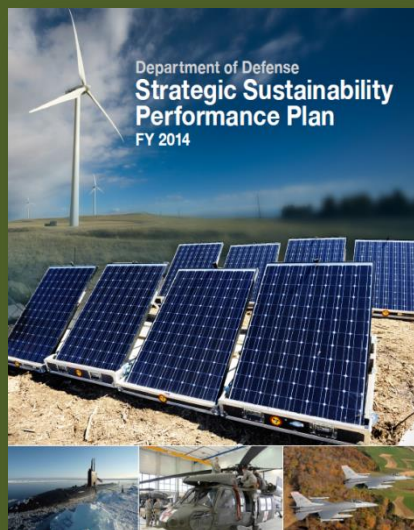


# The DoD Strategic Sustainability Performance Plan (SSPP)



## FY14 DoD Strategic Sustainability Performance Plan

### Objective 3: The Ongoing Performance of DoD Assets Ensured by Minimizing Waste and Pollution



Goal	Target
<b>#5</b>	Solid Waste Minimized and Optimally Managed
<b>Sub Goal 5.2</b>	50% of non-hazardous waste diverted from the waste stream by FY15 and thereafter through FY2020
<b>Sub Goal 5.3</b>	60% of construction and demolition (C&D) debris diverted from the waste stream by FY15 and thereafter through FY2020

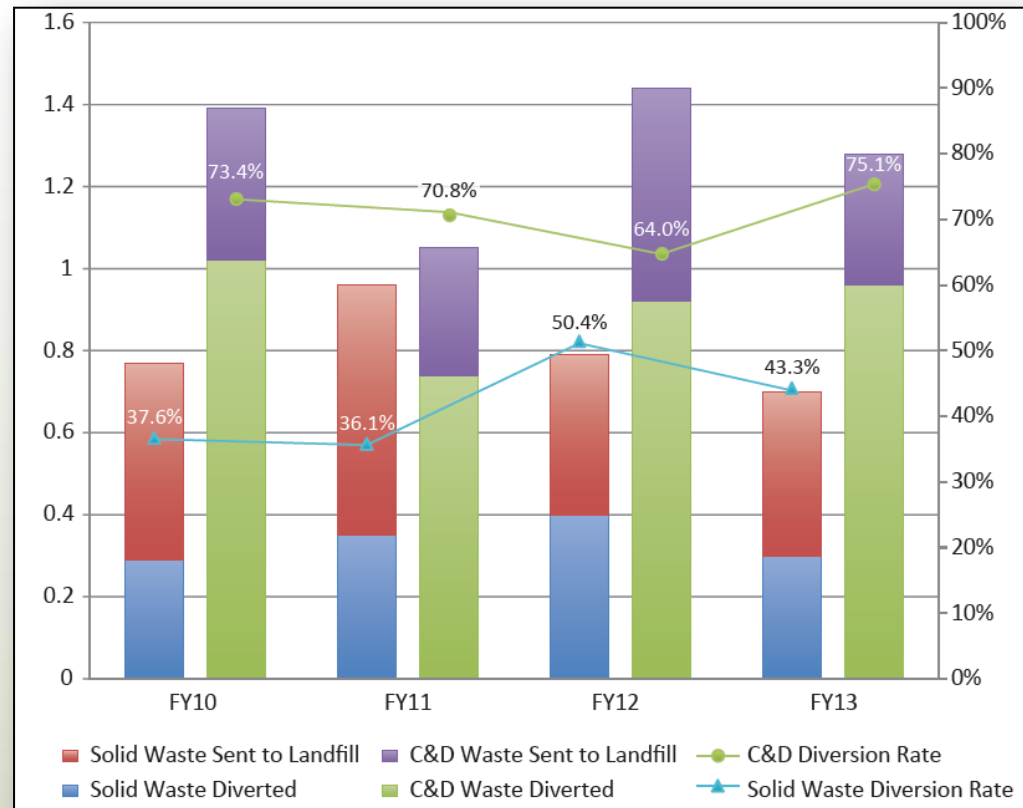




# The Army Sustainability Report (ASR)



In FY13 the Army  
diverted 43% of  
solid waste and 75%  
C&D waste; as  
reported in the FY14  
Army Sustainability  
Report



**Army's progress in diverting solid waste  
and C&D waste from landfills**



# Net Zero Waste Drivers - Mission

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- Land use restrictions
- Limited landfill space
- High transportation and disposal costs
- Climate change – greenhouse gas emissions





# Net Zero Waste Hierarchy



**A Net Zero WASTE** installation will implement Net Zero by: reducing, reusing, recycling/composting and recovering solid waste streams and converting them to resource values, resulting in zero landfill disposal.

## Net Zero Waste Approach Includes:

- Improved purchasing practices
- Recognition that waste is a resource
- Increased recycling and composting
- Energy recovery



# Implementing Net Zero Waste



## WASTE

Reduction

Re-Purpose

Recycling &  
Composting

Energy  
Recovery

Disposal

Optimize Land Use

Awareness/Culture Change

**Goal: No solid waste  
disposal in landfills**

### Waste Reduction

- Improved procurement (e.g., buy less, reduce packaging use “recyclable” content, material)
- Generate less waste (e.g. duplex printing, take-back programs)

### Re-Purpose

- Furniture donations & re-use centers
- Match waste “products” with potential users

### Recycling and Composting

- Installation recycling centers
- Food waste & organics composting

### Energy Recovery

- Waste to energy package systems
- Use only after meeting diversion goals and only where economically feasible

### Disposal

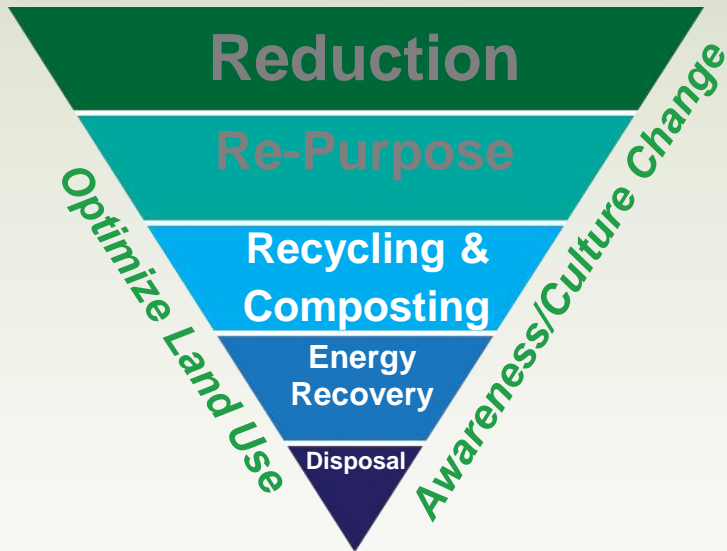
- The goal of Net Zero Waste is Zero landfill disposal
- Landfill disposal should be the last resort after other economically feasible efforts are implemented.



# Implementing Net Zero Waste cont.



## WASTE



**Goal: No solid waste disposal in landfills**

### Waste Reduction

- Improved procurement (e.g., buy less, reduce packaging use “recyclable” content, material)
- Generate less waste (e.g. duplex printing, take-back programs)

### Re-Purpose

- Furniture donations & re-use centers
- Match waste “products” with potential users

### Recycling and Composting

- Installation recycling centers
- Food waste & organics composting

### Energy Recovery

- Waste to energy package systems
- Use only after meeting diversion goals and only where economically feasible

### Disposal

- The goal of Net Zero Waste is Zero landfill disposal
- Landfill disposal should be the last resort after other economically feasible efforts are implemented.



# Net Zero Waste Pilot Installations



## Waste Nominees



## Waste Pilot Installations



## Eight Net Zero Waste Pilot Installations

- Fort Bliss, TX
- Fort Carson, CO
- Fort Detrick, MD
- Fort Hood, TX
- Fort Hunter Liggett, CA
- Fort Polk, LA
- Joint Base Lewis McChord, WA
- USAG Grafenwoehr, Germany

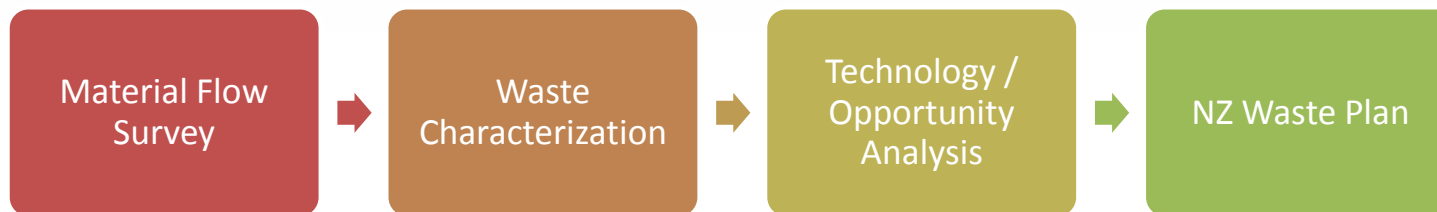
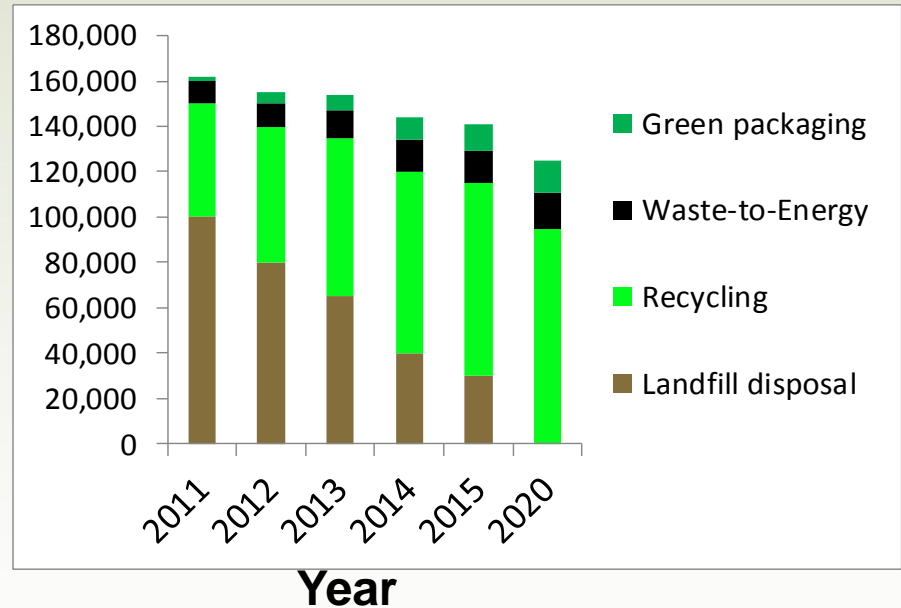
# Net Zero Waste Plan



## Example of How an Installation Might Achieve Net Zero Waste

- Material flow analysis
- **Improved procurement practices**
- Re-purpose / Re-use strategy
- **Recycling & composting strategy**
- **Potentially viable technologies**

Tons of Waste



# Material Flow Analysis

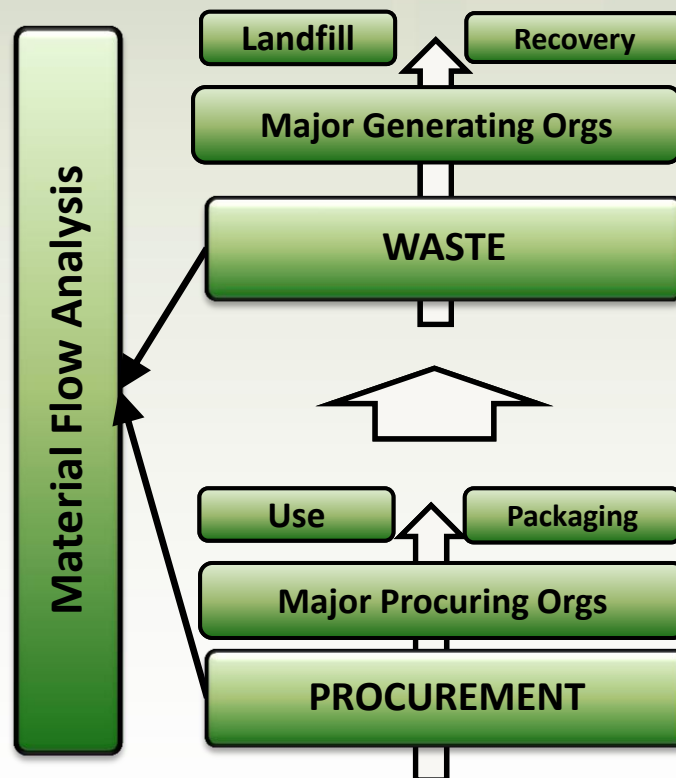


## ■ Objective

- ☐ Analyze waste streams (outputs) and procurement (inputs) to support Net Zero waste strategies

## ■ Approach

- ☐ Use readily available data
- ☐ Organize analysis by activity type
- ☐ Identify priority waste streams for reduction / elimination



# Material Flow Analysis Protocol



## Material Flow Survey:

- Initial Data Collection: readily available data
- Installation Survey / Site Visits: obtain more data



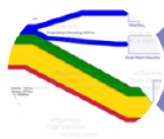
## Waste Characterization:

- Develop New Data
- Support Material Flow Survey



## Material Flow Workbook:

- Compile and Analyze



## Material Flow Diagrams:

- Support Understanding

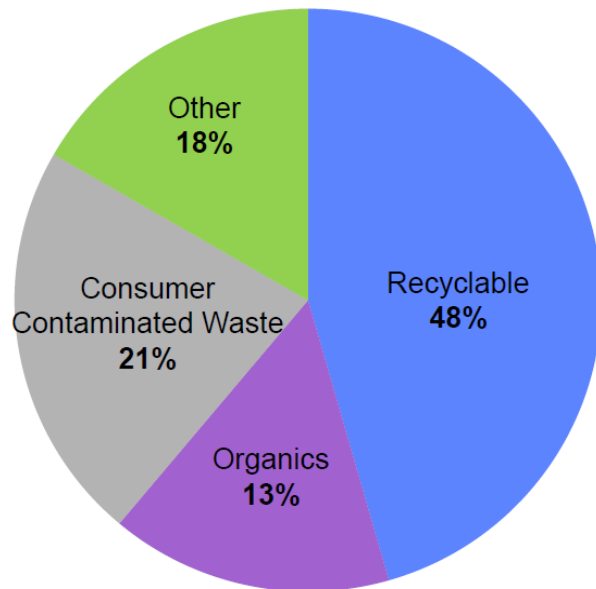


## Technology / Opportunity Analysis:

- Analyze opportunities

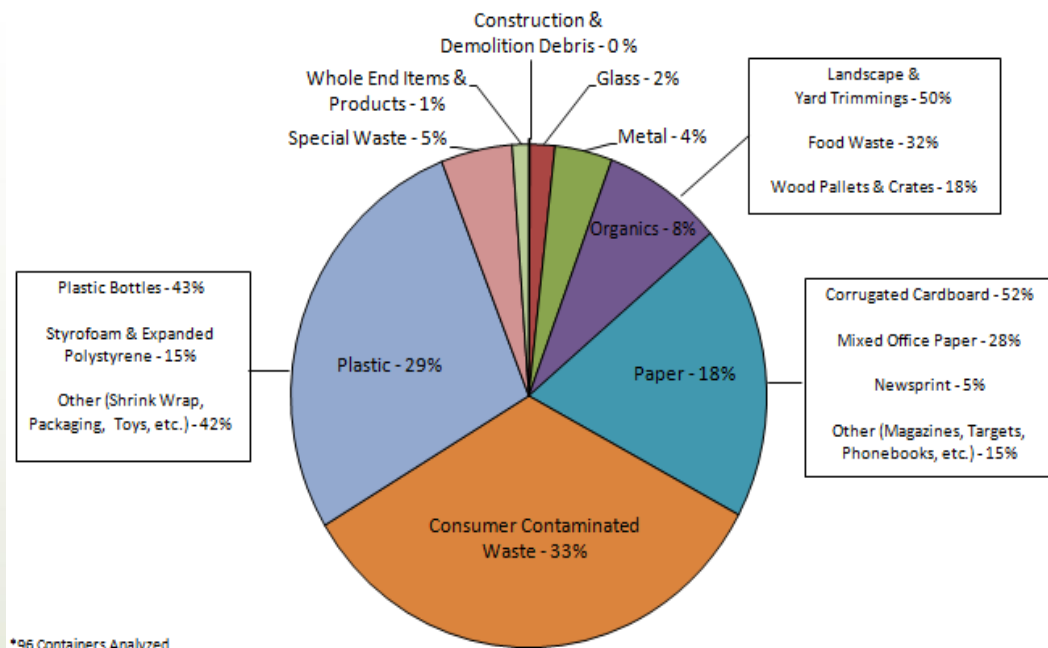


# Material Flow Analysis – Fort Hood



Fort Hood Combined Residential and Commercial Landfill Waste by Weight

Installation Level Municipal Solid Waste By Category, Percent by Volume



Fort Hood Overall Waste Profile



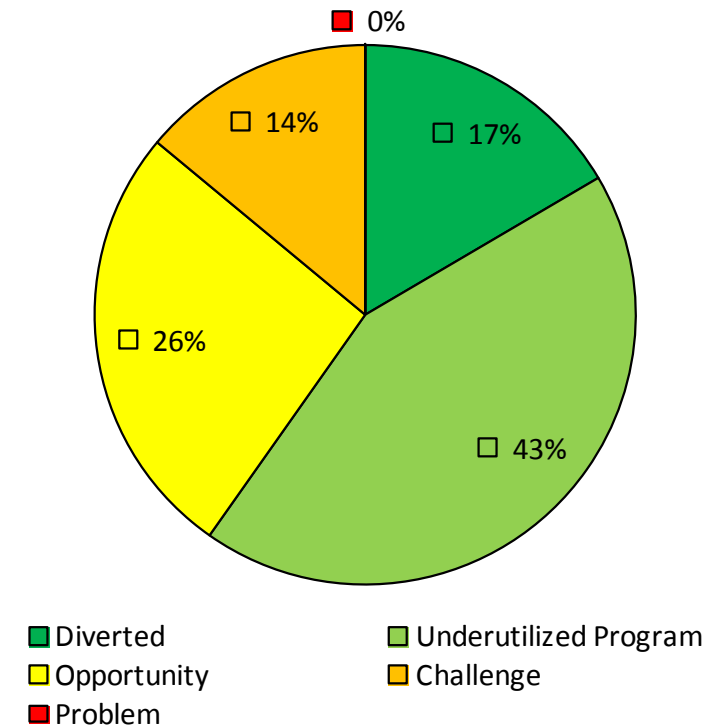


# Material Flow – Divertability

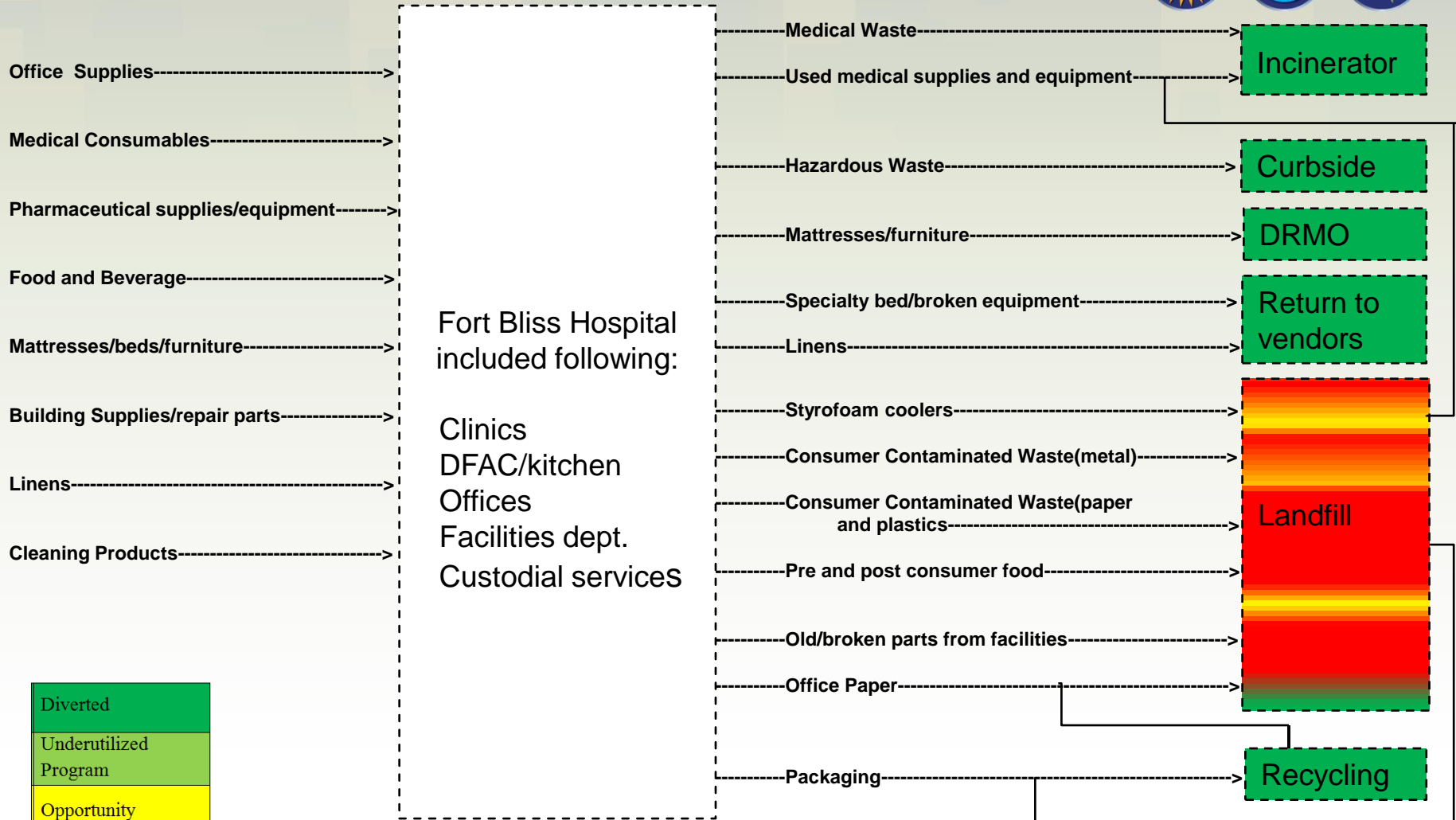


Score	Short Description	Long Description
1	Diverted	Diversion program is in place and estimate at least 90% compliance.
2	Underutilized Program	Diversion program is in place, but less than 90% compliance.
3	Opportunity	Diversion possible through adoption of existing technologies, infrastructure, markets, etc.
4	Challenge	Diversion possible, but will require additional development of available technologies, infrastructure, and/or markets.
5	Problem	Diversion would require development of new technologies, infrastructure, and/or markets.
0	Incomplete Information	Incomplete information about presence and/or destination of waste stream.
	No Waste	Waste stream does not exist for this organization

**Waste Diversion Potential**  
(%waste by mass)



# Material Flow –at Fort Bliss Hospital



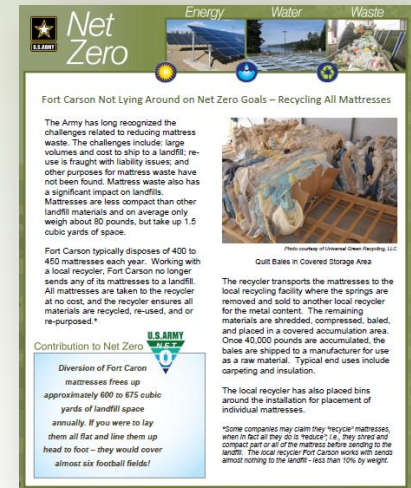
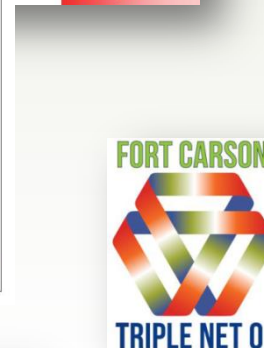
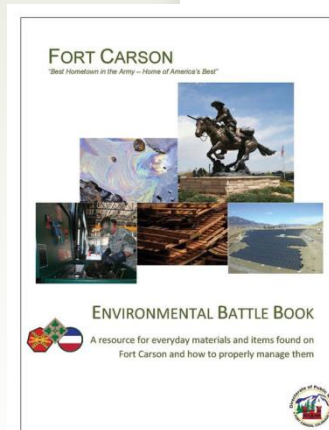
Diverted
Underutilized Program
Opportunity
Challenge
Problem



# Net Zero Waste Successes at Fort Carson a Net Zero Pilot Installation



- **Mattress Recycling Success Story on Army's Net Zero Website:**
- **Green procurement program**
- **Reuse efforts**
  - ❑ Furniture donation program
  - ❑ Porcelain collection with City of Colorado Springs
- **Recycling efforts**
  - ❑ Recycling incentives
  - ❑ Electronics recycling via UNICOR
- **Outreach/Education efforts**
  - ❑ Battle Book
  - ❑ Facility Manager SOP



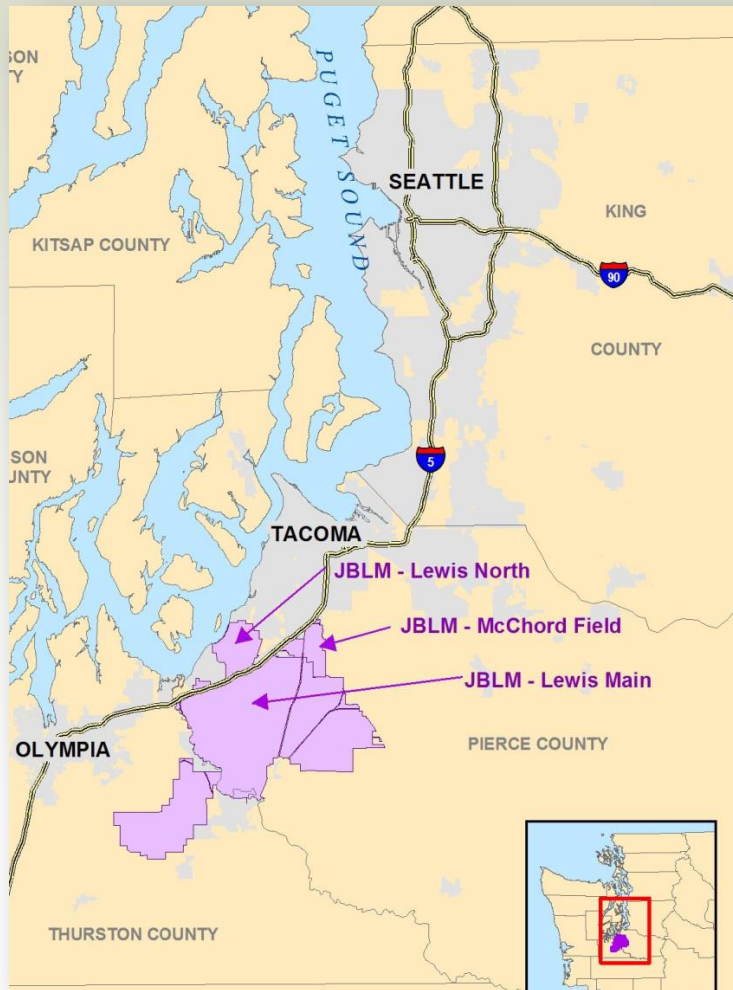
<http://www.asaie.army.mil/Public/ES/netzero/>



**Soldiers participating in the Recycle Incentive Barracks Single Stream (RIBSS) Program bring their recyclables to Fort Carson's Recycle Center to have their items weighed and logged**

# Net Zero Waste Case Study; Landfill #5

## JBLM Asphalt Recycling and Composting



### LOCATION:

- Located near Tacoma, WA in the Pacific Northwest of the US
- Total population is approximately 90,000 people
- Major waste streams include asphalt, concrete, metal, cardboard, and food waste.
- Diversion rate was 64% in 2012; expect increase of 2-4% per year

### JBLM DIVERSION SUCCESS:

- Saves DPW over \$1 M /year for soil/mulch
- 25,000 tons of concrete and asphalt mined from closed landfill and processed
- Current aggregate collected from C&D projects on-base.
- FY2011 totals for concrete and asphalt = 15,600 tons

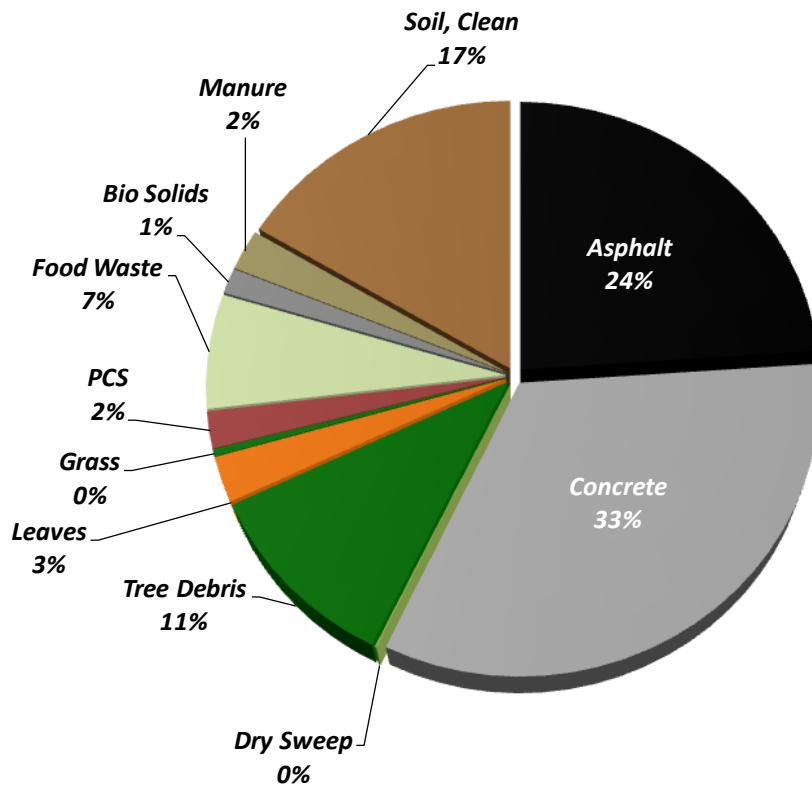




# Net Zero Waste Case Study; Landfill #5 JBLM Asphalt and Concrete Recycling



**Earthworks Recycling Streams FY13**



**Joint Base Lewis-McChord Earthworks  
Asphalt & Concrete Grinding Operations**

# Net Zero Waste Case Study Landfill #5

## JBLM Composting



**Each year JBLM diverts tons of organic wastes:**

- Leaves
- Grass
- Food waste
- Landscaping
- Land clearing debris
- Storm debris
- Stable waste
- Biosolids

**Net Zero**

Joint Base Lewis-McChord Composting Facility – Turning Organic Waste Resources Into Valuable Products

Joint Base Lewis-McChord (JBLM) is turning organic waste resources into valuable landscaping and soil amendment products. Since 2006, JBLM has been diverting organic wastes such as leaves, grass, food waste, landscaping and land clearing debris, storm debris, stable waste, and biosolids (sewage sludge) from off-base landfill disposal or recycling facilities and composting it. During this time period, JBLM has diverted approximately 28,905 tons of organic wastes. A conservative estimate of cost savings for the amount of diverted organic waste is approximately \$2.6M. Since 2006, the JBLM Compost Facility has produced approximately 12,483 tons of compost products with an estimated value of \$187K. JBLM Compost Facility product is used either on base or sold to the public via auction. In 2012 JBLM compost was certified by the United States Composting Council Seal of Testing Assurance program. This certification is the gold standard for compost product in the United States.

**Contribution to Net Zero**

JBLM contributes to Net Zero Waste by diverting organic wastes such as leaves, grass, food waste, landscaping and land clearing debris, storm debris, stable waste, and biosolids (sewage sludge) from landfill disposal and off-base recycling by composting these resources into valuable soil enhancement and landscaping products for use on JBLM or for sale to the public by the JBLM Qualified Recycling Program.

**Screened Compost Product**

According to a solid waste characterization survey conducted in 2012 it was determined that approximately 31% of the JBLM waste stream was organic waste that could be diverted and composted. The survey also identified sources and activities that generate organic wastes at JBLM. The survey information will be used to strategically direct future efforts to divert even more organic wastes to meet Net Zero Waste goals. Composting organic wastes at JBLM has proven itself to be a sound investment both environmentally and economically. The JBLM Composting Facility is a "community connector" with various interest groups that regularly tour the facility. The Composting Facility has received positive recognition by the Washington Organic Recycling Council who regularly tours with students from their Composting Operator course. The JBLM Composting Facility has operated successfully since 2006 and continues to meet the present and future needs of JBLM in support of the Army's vision of "Net Zero Waste by 2020".

The JBLM Composting Facility has received recognition from the Washington Organic Recycling Council who regularly tours with students from their Composting Operator course.





# Net Zero Waste Successes; Fort Polk



**Energy**

**Water**

**Waste**

### Fort Polk Charged Up Over Lithium Battery Reuse

The aggressive training mission of the Joint Readiness Training Center (JRTC) at Fort Polk, Louisiana presents significant challenges to protecting the environment without impacting the mission. The JRTC provides highly realistic, stressful, joint and combined arms training for units in 3 week rotations, leaving little time for clean-up following the exercise, even less for the management required of the 12-volt lithium batteries (BA 5590 and BA 5390) used during their rotations. Each year units turn in about 1,200 of these batteries at the end of their 3 week training at the JRTC, nearly half of which are still usable (70% of battery's life span remaining). Seeing an opportunity to reduce battery expenditures, waste disposal costs and potential injury to soldiers, JRTC and Fort Polk personnel developed a program for the turn-in, testing and re-issue of these batteries. Testing the batteries to determine life span requires special equipment employed by personnel specifically trained in safely discharging and operating the testing equipment.

**New Lithium Battery Tester to replace out dated LS 94 Tester at Fort Polk**

The batteries were first tested using an Energage LS 94 State-of-Charge-Tester. Those batteries determined to have more than 70% of their life span remaining are reissued. Personnel working with the batteries are trained to operate the equipment safely and utilize personal protective equipment to avoid exposure to the acid gases in the event of a violent discharge. The antiquated (over 20 years old) LS 94 State-of-Charge Tester has been replaced with a newer, faster, less expensive test set manufactured by Raven Research & Development.

Re-issue of the BA 5590 and BA 5390 lithium batteries at JRTC & Fort Polk has resulted in a cost avoidance of more than \$450,000 annually. Additionally, environmental compliance, waste reduction, and worker health and safety have also improved.

For information on how to obtain your own battery tester contact Philip St Romain.

**Contribution to Net Zero**

**Challenges for Fort Polk in Meeting Net Zero Goal**

**Most Challenging Waste Stream:**  
Field waste and all Consumer Contaminated Waste (CCW)

**Largest Waste Stream:**  
By wt.: Construction and Demolition (C&D)  
By concern: Field waste includes food/CCW

**Most Successful Diversion:** C&D

**Least Successful Diversion:** Field Waste

**Most Progress:** Paper

- Cut empty fire extinguishers, sell as scrap metal
- Reissue and donate serviceable government-issued cell phones
- Disassemble unusable metal furniture and sell as scrap metal
- Require furniture vendors take back packaging
- Purchase recyclable and longer lasting foam mattresses

Batteries turned in are tested and if determined to have more than 70% of their life span remaining are reissued.

<http://www.asaie.army.mil/Public/ES/netzero/>



# Net Zero Waste Best Practices

## 2012 Net Zero Progress Report

---



### Best Practices identified in the 2012 Net Zero Progress Report of the Net Zero Pilot Installation Initiative include:

- Establish a Qualified Recycling Program
- Characterize and quantify waste flows
- Improve purchasing practices to reduce waste at the source
- Repurpose and reuse waste through free and low-cost opportunities
- Recycle waste through free and low-cost opportunities





# Net Zero Waste Best Practices

## 2012 Net Zero Progress Report (cont.)

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### **Best Practices identified in the 2012 Net Zero Progress Report of the Net Zero Pilot Installation Initiative include:**

- Establish a Qualified Recycling Program
- Characterize and quantify waste flows
- Improve purchasing practices to reduce waste at the source
- Repurpose and reuse waste through free and low-cost opportunities
- Recycle waste through free and low-cost opportunities



# Net Zero Waste Best Practices

## Expand Existing Recycling Program



- Recycle additional items
- Single Stream Recycling
- Decrease contamination of waste
- Upgrade processing equipment
- Increase storage
- Promote new initiatives
- Manually remove recyclable items



# Net Zero Waste Best Practices

## Expand Recycling Program

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- Bring Your Own Bag Campaigns
- Clean and Re-Use Shop Rags
- Recycle Wrap
- Substitutes for Packaging Materials
- Re-Use of Textiles and Linens
- Setting Printers to Double-Sided Printing



# Net Zero Waste Best Practices

## Expand Recycling Program (cont.)

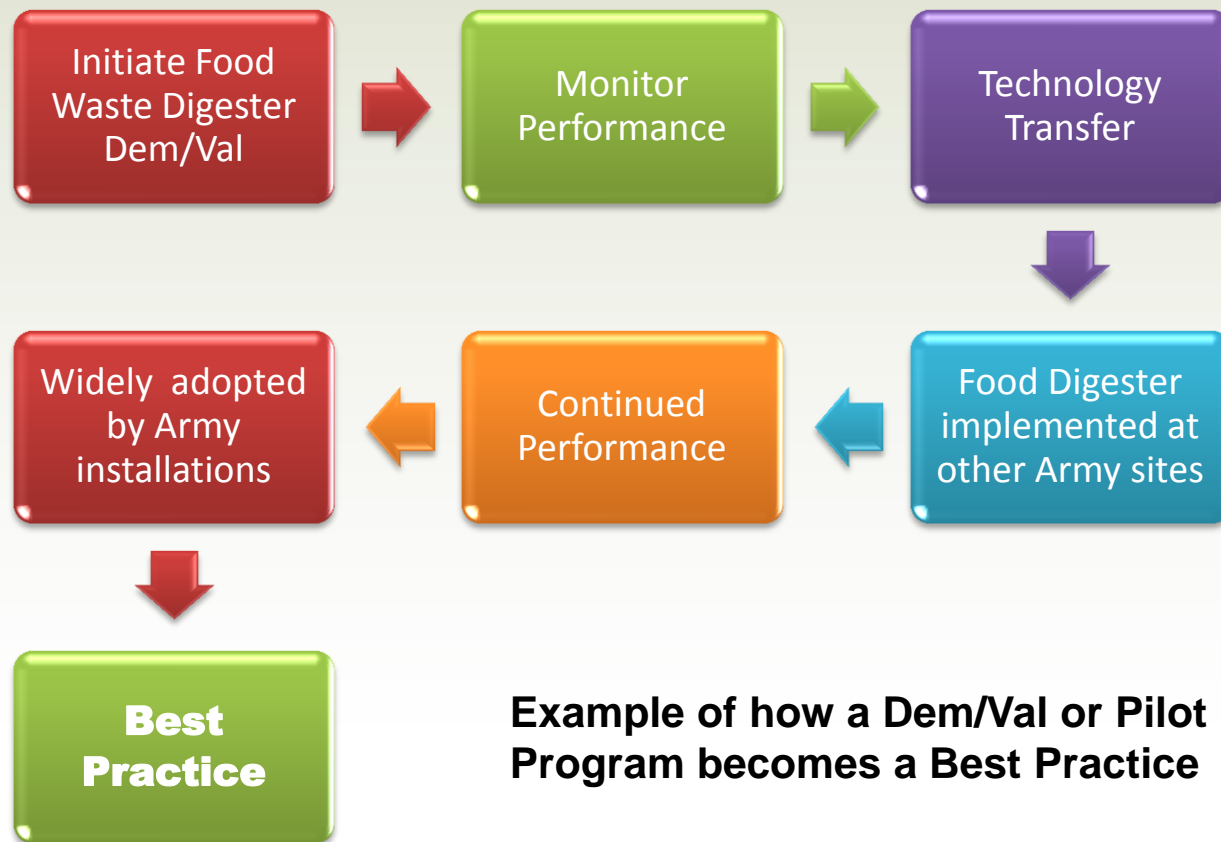
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- Co-locate Recycling Bins
- Establish Recycle Challenge Programs and Contests
- Performance-Based Contracting
- Social Media



# Pilot Programs and Demonstration/Validation (Dem/Val) Opportunities



**Example of how a Dem/Val or Pilot Program becomes a Best Practice**



# Net Zero Waste Best Practices Pilot Programs and Dem/Vals

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- Electric Hand Dryer Pilot Programs
- Food Waste Donation with External Organizations
- RecycleMatch Demonstrations
- Manufacturer Take-Back Programs



# Net Zero Waste Best Practices Pilot Programs and Dem/Vals

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- Dining Facility ***Pre-Consumer*** Food Waste Pilot Program
- Dining Facility ***Post-Consumer*** Food Waste
- Food Waste Digesters, Dehydrators, and In-Vessel Compost Systems
- Composting Methods and Technologies



# Composting Technologies

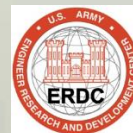
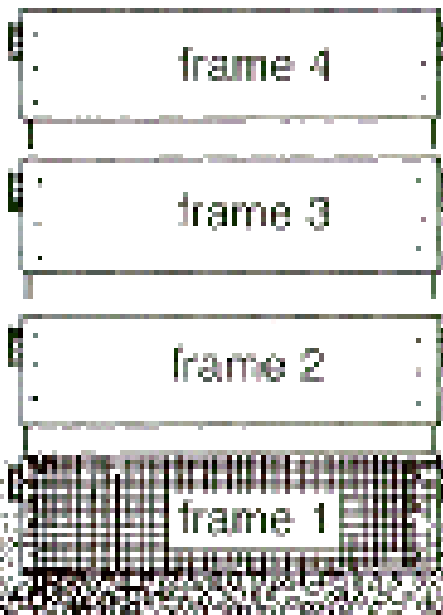


## Vermi-posting

- Characteristics
  - Simple, near-site, small-scale, educational opportunity
- Throughput
  - 1000 lbs. food waste/(year\*yd<sup>2</sup>)
  - 1000 lbs. carbon source/(year\*yd<sup>2</sup>)
  - 600 lbs. compost/(year\*yd<sup>2</sup>)
- Water Requirement (+)\*\*
- Energy Requirement (-)
- Cost (+)

\*\*

(+) minimal  
(++) moderate  
(+++) significant  
(-) no requirement



US Army Engineer Research  
and Development Center





# Composting Technologies



## Food Waste Digesters

- Characteristics
  - ❑ Simple, on-site, medium-scale
  - ❑ Currently being tested at Fort Hood, TX
  - ❑ ORCA-Organic Refuse Conversion Alternative
- Throughput
  - ❑ 16-100 lbs/ hour
  - ❑ 3-15 gallons water/hour
- Water Requirement (++)\*\*
- Energy Requirement (+)
- Cost (++)

(+) minimal  
(++) moderate  
(++) significant  
(-) no requirement



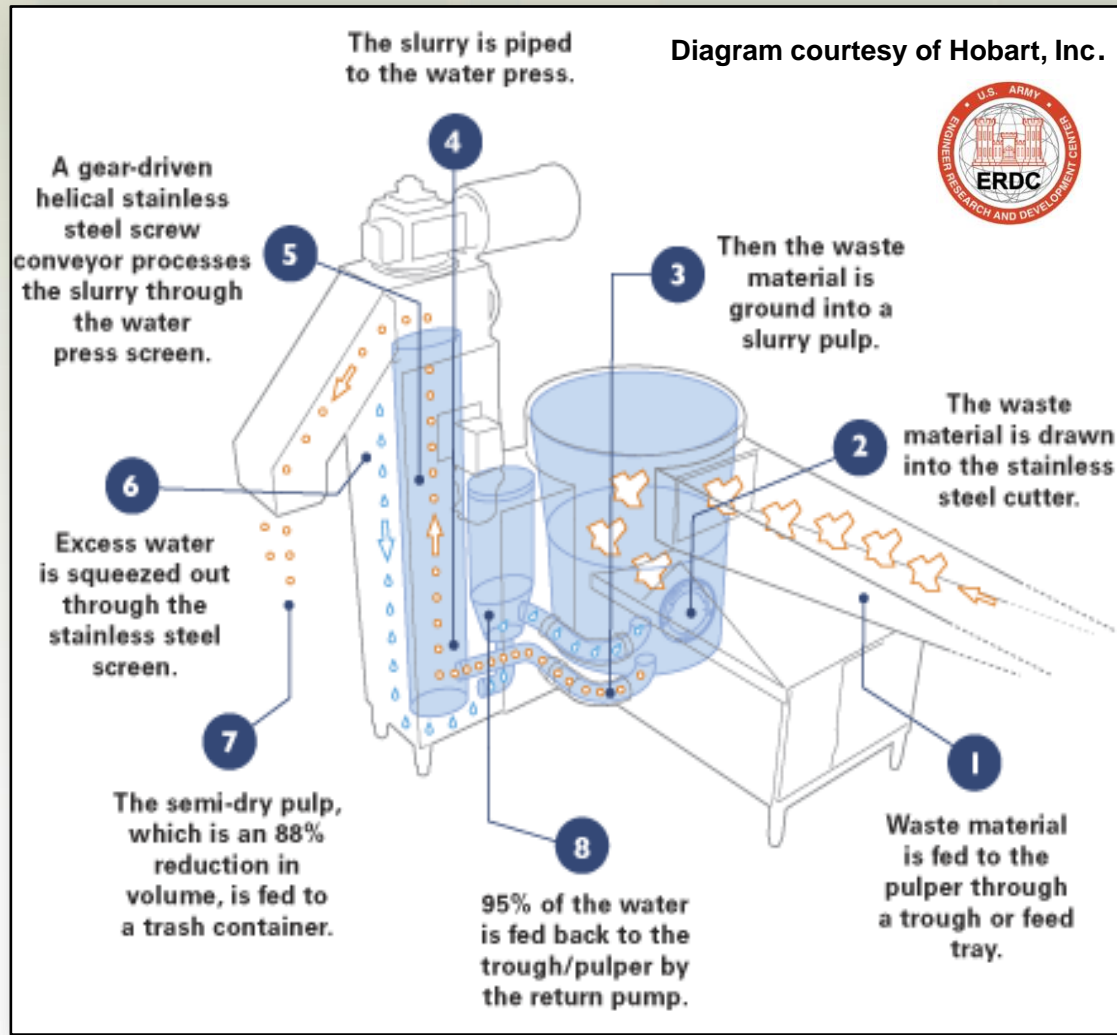
Photos courtesy of Totally Green, Inc., Tulsa OK



US Army Engineer Research  
and Development Center



# Composting Technologies



## Food Waste Pulpers

- Characteristics
  - ❑ Simple, on-site, medium-scale
- Throughput
  - ❑ 700-3000 lbs/ hour
  - ❑ Water recycled
  - ❑ 80-90% waste volume reduction
  - ❑ 80-360 lbs/hour
- Water Requirement (++)\*\*
- Energy Requirement (+)
- Cost (++)

\*\*

(+) minimal

(++) moderate



# Composting Technologies



US Army Engineer Research  
and Development Center



## In-Vessel Aerobic Systems

### Characteristics

- Simple to complex, off-site or near –site
- Medium to large-scale
- Carbon source bulking material required
- Efficient with short turnover times
- End product may require additional curing time
  - ❑ Secondary storage facility required

### Throughput

- 1,000-10,000 lbs food waste/week
- Custom designed to meet needs specifications
- Compost retention times vary from 7-21 days
  - ❑ Additional, secondary curing times of 6-8 weeks

- Water Requirement (++)\*\*

Energy Requirement (+) to (+++)

Cost (+) to (+++)

\*\*

(+) minimal

(++) moderate

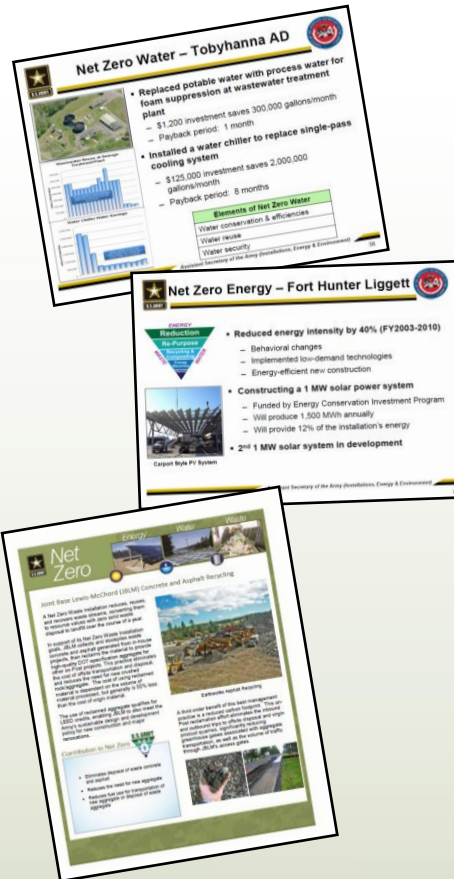
(++) significant



# Internal and External Collaboration



- Share and document lessons learned
- Build cross-functional Net Zero teams
- Assist each other with challenges
- Conduct monthly calls and periodic progress meetings



- Local and regional authorities
- Federal Government
- Public-private partnerships



# Best Practices – Lessons Learned

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- Collaboration and teamwork is key!
- Set smart goals
- Command support is needed for project execution
- Changing behavior is as important as efficient technologies
- Procurement practices affect type & volume of waste generated





# Lessons Learned at Fort Polk



## PCA Cellulose Land Application Project

- Used pulp – a byproduct
- Tilled into ground, seeded and fertilized
- Unsuccessful – would not compact
- Collaboration



Photo showing soil separation above to the left a photo showing results of soil that would not compact.



# Questions?

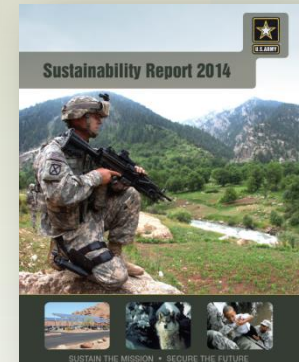


## Army Sustainability Report 2014

<http://usarmy.vo.llnwd.net/e2/c/downloads/367149.pdf>

## Office of the Assistant Secretary of the Army for Installations, Energy and Environment

<http://www.army.mil/asaiee>



## Office of the Deputy Assistant Secretary of the Army, Energy and Sustainability

<http://www.asaie.army.mil/Public/ES/>

## Army Net Zero

<http://www.asaie.army.mil/Public/ES/netzero/index.html>



**Slide 1: Title Slide**

I am Kristine Kingery. I work in the Army Secretariat in the Office of the Assistant Secretary of the Army for Installations, Energy and Environment. I am the Director of Army Sustainability Policy and the Army lead for the Net Zero Installation Initiative. Thank you for tuning in to Session 5 of the Net Zero online training.

**Slide 2: Module 5 – Net Zero Waste**

This is Module #5 –Net Zero Waste. This slide lists the topics that will be covered during this session.

First I'll go over the objectives of this training and what will be accomplished – and basically, what you should know by the end of this session.

We'll cover the driving forces behind Net Zero Waste: And when we talk about drivers, we're not just taking about the regulatory drivers such as the policies, regulations, and goals set forth in Presidential Orders, DoD Directives and Strategic Sustainability Performance Plans. More important forces that drive the Net Zero goals include the physical and environmental limitations that are or can potentially be a threat to continued mission at an Army installation – such as land use and waste disposal costs.

I discussed the Net Zero hierarchy in detail in the 1<sup>st</sup> and 2<sup>nd</sup> module and briefly went over the Net Zero *Energy* hierarchy in Module #3 – Net Zero Energy – and the Net Zero *Water* hierarchy in Module #4 – Net Zero Water and for this session I will revisit the inverted triangle that represents the Army's priority of approaches to Net Zero Waste.

We'll 're-review' the Army's Net Zero Pilot Installation Initiative specific to the Net Zero Waste pilots and provide an overview of what these Net Zero Waste pilots have accomplished and what we have learned through their activities of three plus years being a Net Zero Waste pilot.

We will look at where to begin and the approach to implementing Net Zero Waste.

And finally, information and guidance will be provided on processes, programs, and procedures related to Net Zero Waste that have been determined to be a "Best Practice" at Army installations, stellar examples, challenges identified or "Lessons Learned" and potential sources of funding.

Ok now let's talk about why you're here.

**Slide 3: Learning Objectives**

The objective of this training is to present relevant information you can use to support your installation in its pursuit of Net Zero Waste.

By the end of this session you should:



1. Understand how the Army's Net Zero Waste definition supports our efforts to meet and/or exceed mandates, regulations and goals.
2. Understand how waste impacts Army Installations and the Army mission.
3. Delve into the concepts, data, and resources required to develop an approach to implementing Net Zero Waste including material flow analysis, waste characterization and identifying and implementing waste reduction, re-use, and diversion opportunities.
4. Know the resources and best practices available to determine what might work at your installation.

Now let's review what's driving the Net Zero initiative in terms of regulatory drivers and mission impact drivers. Regulatory drivers motivate actions taken to comply with requirements which are relatively straight-forward and involve tangible numerical metrics. Mission impact drivers motivate actions taken towards Net Zero to mitigate risk to an installation's mission.

#### **Slide 4: Net Zero Waste Drivers – Mandates and Policies**

Regulatory. The recent history of Army waste regulatory drivers:

Executive Order or EO 13423, Strengthening Federal Environmental, Energy, and Transportation Management, signed in January 2007, established several waste management requirements for federal agencies including that each agency increase diversion of solid waste, maintain cost effective waste prevention and recycling programs in their facilities; and use environmentally sound practices in the disposition of agency electronic equipment. In addition, EO 13423 directs agencies to use sustainable environmental practices, including the acquisition of biobased, environmentally preferable, energy-efficient, water-efficient, and recycled-content products, and use paper with at least 30 percent post-consumer fiber content. (The use of recycled content products and post-consumer fiber paper does not directly reduce the installation waste stream; however it does contribute to conserving natural resources and increased the demand for recycled content products, incentivizing the recycling economy.)

In February 2007 DoD implemented the DoD Integrated Solid Waste Management Policy which established a 40% diversion rate goal for non-hazardous solid waste and a 50% diversion rate goal for C&D waste by 2010. The DoD surpassed the C&D waste diversion rate goal by diverting 73% of C&D waste in 2010. The DoD missed the non-hazardous waste diversion rate goal by 1%.

The Army Integrated Solid Waste Management Policy incorporates the DoD policy waste diversion goals into the installation Integrated Solid Waste Management plans, required by AR 420-1 and also requires reporting on installation progress toward these goals in SWARWeb.

EO 13514 Federal Leadership in Environmental, Energy, and Economic Performance, signed in October 2009, quantified sustainable procurement requirements by mandating that 95% of contracts for goods and services to be conducted sustainably. This requirement directed Federal Agencies to ensure that contract actions including task and delivery orders for products and services, with the

exception of weapons systems, are energy efficient (including Energy Star and Federal Energy Management Plan designated products), water-efficient, biobased, environmentally preferable (including Electronic Product Environmental Assessment Tool (EPEAT) certified electronic products), non-ozone depleting, contain recycled content, and are non-toxic or less-toxic alternatives. In addition, Federal Agencies were directed to employ environmentally sound practices in the disposition of excess or surplus electronic products. Sustainable procurement is important because it can reduce waste generation at the source (as well as energy and water consumption). EO 13514 also required that printing paper use be reduced and duplex printing policies be implemented.

### **Slide 5 Goal Setting and Progress Reporting**

EO 13514 requires Federal agencies to prepare & submit an annual Strategic Sustainability Performance Plan (SSPP)

OSD prepares the DoD SSPP (applicable to Army, Air Force, Navy, etc.). The Army provides its annual progress information on all of the goals reported in in the SSPP to the OSD.

The Army also reports its sustainability implementation progress via the Army Sustainability Report or ASR

The 2014 Army Sustainability Report was released in October

### **Slide 6 – The DoD SSPP**

The DoD Strategic Sustainability Plan (SSPP) is updated annually to establish DoD sustainability goals and implement the requirements of Federal sustainability directives including EOs 13423 and 13514. Net Zero Waste related goals in the FY14 DoD SSPP fall under Objective 3: The Ongoing Performance of DoD Assets Ensured by Minimizing Waste and Pollution – Goal 5 Solid Waste Minimized and Optimally Managed. Subgoals 5.2 and 5.3 set waste diversion rate goals - 50% diversion of non-hazardous solid waste and 60% of C&D waste diverted from the waste stream by FY15 and thereafter through FY2020.

The other sub goal under Objective 3; Goal 5 of the FY14 DoD SSPP (Sub goal 5.1) relate to implementing policies to reduce the use of paper.

### **Slide 7 ASR**

This figure is taken from the ASR14 and shows the Army's progress in diverting solid waste and C&D waste from landfills. In FY13, the Army diverted about 304,000 tons of solid waste from landfills and 957,000 tons of C&D debris for reuse — 43 percent of solid waste and 75 percent of C&D waste. While the Army's end goal is Net Zero waste, it is progressing toward the DoD goal to divert 50 percent of non-hazardous solid waste and is exceeding the goal to divert 60 percent of C&D debris from the waste stream by FY15.

The Army recycles more than cans, paper, plastic, and glass. It collects and reuses or recycles electronics, scrap metal, cardboard, wooden shipping crates, and other materials. The Army properly disposes of old or surplus electronics in accordance with EO 13514, using the Defense Logistics Agency's Disposition Services. Army installations also compost landscaping wastes. In FY13, it tripled the amount of composted material to 34,358 tons.

Next we'll review Net Zero drivers that stem from threats to mission continuation such as land use restrictions and rising waste disposal costs

### **Slide 8: Net Zero Waste Drivers - Mission**

DoD and municipal solid waste landfills are filling up. Expanding existing landfills or constructing new DoD landfills takes up land space that can be utilized to support other vital Army activities. In addition, regulatory and compliance burdens make it difficult to expand existing or build new landfills and even to continue operating current landfills. As landfills close and new landfills are not opened, waste must be transported greater distances resulting in increased disposal and waste transportation costs and increased greenhouse gas emissions. By reducing and ultimately eliminating landfill waste, the DoD can preserve land and reduce costs associated with waste disposal.

Now that we understand the driving issues, let's shift our focus back to Net Zero Waste and revisit the Army Net Zero Hierarchy.

### **Slide 9: Net Zero Waste Hierarchy:**

This Slide shows the inverted triangle for the Army's Net Zero Waste hierarchy and how Net Zero Waste was specifically defined in the 28 January 2014 Army Net Zero Directive.

I'll PAUSE for a moment so you can review the definition of Net Zero Waste.

The Net Zero Waste hierarchy indicates that reduction, or avoidance of waste all together, is the most efficient strategy for minimizing waste and reaching our goal.

Re-purposing or re-using waste products and materials is the next most efficient since the complete value of the goods are retained and the re-used goods are substituted for goods that would have been purchased new. This eliminates the resources needed to manufacture new products.

Recycling is the next most efficient - it retains some material value of the goods and materials, but requires energy and resources for processing. Composting is a way to recycle organic food wastes.

Energy recovery is at the bottom of the Net Zero hierarchy and is the least efficient because it only retains the thermodynamic value of the materials used in the goods; it also requires energy and resources for processing. Energy recovery is the final method that should be considered to divert otherwise non-reusable, non-recyclable waste from landfill disposal.

As installations follow the hierarchy, they see reductions in the amount of solid waste disposed, as the goal of a Net Zero Waste installation is to have zero solid waste landfill disposal.

Approaches to achieving Net Zero Waste include improved purchasing practices. For example, buying less and buying better, such as buying recycled as well as recyclable content, and bio-based products. Procuring products that produce less waste, including packaging waste, and that are easily re-purposed or recycled impacts the first three levels of the net-zero hierarchy. The implementation of take back policies into procurement contracts also reduces waste generation by returning packaging materials and products that have reached the end of their useful life back to manufacturers for re-use or recycling.

Waste should be viewed as a resource that contains value either through re-purposing, recycling or composting.

A final holistic approach is energy recovery. After every bit of waste is re-purposed, recycled, or composted then an appropriate disposal methodology is waste-to-energy. Waste to energy enables the capture of the energy value products and reduces waste to be landfilled.

Now we will expand our discussion of the approach to implement the Net Zero Waste hierarchy.

### **Slide 10: Implementing Net Zero Waste**

These are the steps in the approach to implementing Net Zero Waste corresponding to the Net Zero Waste hierarchy.

Waste source reduction is the top priority. If you do not generate the waste, then you do not have to divert it or dispose it. Waste reduction can be achieved by changing how we buy and how we use products and materials. Procurement practices can be implemented to buy materials that generate less waste, have longer service lives, and can be more easily diverted from the waste stream. For example, requirements for reduced packaging can be included in procurement contracts and, when packaging is required, contracts can specify packaging that is easily reusable, recyclable or compostable. Take back programs are another way to reduce waste generation. Take back programs allow the return of products to the manufacturer after their useful life. Take back programs are gaining popularity in areas such as electronic equipment. Changing the way we use products can also reduce waste. For example, duplex printing, printing on both sides of a sheet of paper, significantly reduces paper waste. Reducing waste source generation not only reduces the waste we have to dispose, it reduces costs because we get more use out of the products and materials we procure.

The next approach to implement Net Zero Waste is re-purpose. Re-purpose, or re-use, is the subsequent use of a product after the initial first use with no changes to the products identity or application. Establishing an installation re-use program can divert waste and save money. Re-use centers receive unused products and supplies and redistribute them to other organizations. For example, if a unit has materials with a remaining shelf life that they will not use, the unit can give their excess materials to the re-use center instead of disposing of them. The re-use center can then distribute these items to units that need them. This not only saves disposal costs, it saves procurement costs for the unit receiving the items. Other examples of re-purpose include the

donation of used furniture to charitable organizations and the donation of used hospital linens to veterinarians and animal shelters for bedding. The key to re-use is finding a recipient that can re-purpose the products for their own needs, first within the installation and then within the surrounding community. We continue on the next slide

### **Slide 11 Implementing NZ Waste...cont.**

The next element of Net Zero Waste is recycling and composting. Recycling has become a standard practice for the Army and in our daily lives. Recycling is the process of recovering materials from the waste stream for use in other applications or in the manufacture of new products. After re-purpose, all waste streams should be evaluated for recycling potential. Qualified Recycling Programs are the basis for these activities and enable installations to receive the proceeds from the sale of recycled materials. Recycling entails several activities including collection, separation, and processing. All of these activities must be in place at the installation to maximize the efficiency of installation recycling programs.

Composting is a process to decompose organic materials into a nutrient rich material for use in landscaping applications. Composting can divert organic waste that has no other material resource value. It is estimated that 25 to 50 percent of our municipal solid waste is compostable. Composting is a resource for installations to improve landscaping, reduce watering requirements, control erosion, and reduce fertilizer usage. Composting can be achieved either on-site or through a local off-post composting program.

The next element of Net Zero Waste is energy recovery. This is the final method that should be considered for waste stream diversion after all other diversion goals have been met and re-purpose, recycling, and composting options have been exhausted. The Net Zero Waste installations considered waste to energy only working thru all the upper levels of the Net Zero Hierarchy. Ideally, installations will collaborate to utilize regional waste to energy facilities where available. Once waste reduction, re-purpose, re-cycle and composting is maximized, the remaining waste stream is expected to be significantly smaller. This allows for the use of small "package" waste to energy units for on-post use if off-post waste to energy options isn't available.

And finally disposal. Zero landfill disposal is the bottom line to Net Zero Waste. Realistically there may always be a small amount of waste that cannot be economically reduced or diverted. This is the last resort and what we want to avoid.

Let's take a look at the pilot installations have accomplished.

### **Slide 12 Net Zero Waste Pilot Installations**

One of the first efforts the Army Net Zero Team launched was in support of the Net Zero Pilot Installation Initiative – a data collection website to review the 24 Net Zero Waste nominations from candidate installations world-wide. The following eight (8) Army installations were selected as Net Zero Waste pilot sites: Fort Bliss, Texas; Fort Carson, Colorado; Fort Detrick, Maryland; Fort Hood, Texas; Fort Hunter Liggett, California; Fort Polk, Louisiana; Joint Base Lewis McChord, Washington;

and U.S. Army Garrison Grafenwoehr, Germany. The Army Net Zero Pilot Installations Initiative has been a success due in large part to the continued outreach, technical support and educational opportunities provided by the Army Net Zero team to installations.

Through three plus years of working with and gleaning knowledge (lessons learned and best practices) from the Pilot Installations, the Army has a better understanding of what installations need to do to move forward in their journey towards Net Zero Waste. The Net Zero Pilot Installation Initiative allowed the Army to identify best practices and lessons learned that can be used to guide all installations in achieving their Net Zero goals. Capturing lessons learned and incorporating best practices in installation operations and management is a crucial step in institutionalizing Net Zero across the Army enterprise.

### **Slide 13: Net Zero Waste Plan:**

Generally, a Net Zero Plan (previously referred to as a Roadmap) describes the strategy for achieving an installation's Net Zero goals. Current waste generation is compared with the desired end-state. Ideally, a Net Zero Waste plan builds a strategic framework from which an installation can identify and implement initiatives to help drive them towards Net Zero. The plan will contain specific projects, sequenced over several fiscal years, with the progress that each project will make towards Net Zero clearly identified.

Comparing current waste generation with the desired end-state starts with a Material Flow Analysis or MFA. An MFA looks at "outputs" (which is the current waste disposal) as well as "inputs" (like purchasing data). This links the volume of waste generated by activity with the source of that waste in the supply chain. The material flow analysis also establishes a baseline and identifies an installation's priority waste streams. A plan is then developed that presents strategies and specific projects for reducing or eliminating those waste streams.

Here you can see how an installation might achieve Net Zero Waste in 2020 by increasing recycling, developing waste-to-energy projects and implementing green packaging. The graph indicates progress toward Net Zero Waste through the implementation of the Net Zero Waste Hierarchy. From year to year the total tons of waste generated decreases as shown by the decrease in the composite bars. Sustainable procurement increases are shown by the increase in green packaging. Recycling and waste to energy also increases year to year. The reduction in waste generation and the increase in waste diversion lead to a decrease in landfill disposal.

Now we will take a closer look at material flow analysis.

### **Slide 14: Material Flow Analysis**

Net Zero Waste planning starts with a Material Flow Analysis. The material flow analysis looks at the lifecycle of waste from its generation to its disposal, balancing waste input and output. This information, as well as general information about existing waste diversion technologies, infrastructures, markets, etc., is used to assess the relative ease by which each material category can be diverted. The Material Flow Analyses looks at readily available data, including:

- Annual Solid Waste disposal data, by waste category
- Army supply & purchasing system data
- Previous waste characterization studies

Analyzing purchasing data /inputs means that we are engaging the procurement aspect in waste management and Net Zero Waste. This in itself is a critical step as source reduction starts with procurement.

The data analysis is organized by installation “activities” (such as dining facilities, construction activities, or vehicle maintenance) vs. waste types or organizations. This allows installations to develop consistent waste avoidance or diversion strategies for that entire ‘activity’ across the installation.

### **Slide 15: Material Flow Analysis Protocol**

A protocol for conducting material flow analyses was developed and demonstrated at six of the Army Net Zero Waste pilot installations. This protocol standardizes the material flow analysis process and is a systematic method for describing and quantifying the materials brought onto the installations and the resulting waste streams. The first step is a material flow survey of material and waste flows. This links waste that is going to landfills with waste-generating activities, focusing on material inputs and those organizations and activities that are involved in procuring/producing the material.

To support the material flow survey, the waste streams are examined to identify their composition, including visual examination of waste that is going to the landfills.

A workbook was then designed that aggregates a variety of organizational, waste, and purchasing data into a single “repository” for analysis.

The workbook enables installations to query the material flow data and develop material flow diagrams to “see” material data flow.

The workbook and the diagrams help installations identify the largest volumes of waste by type and prioritize different reduction opportunities. Technologies and methods can then be identified to address these waste streams by reducing waste input and increasing waste diversion.

Now let’s look at an example of material flow analysis and waste characterization.

### **Slide 16: Material Flow Analysis – Fort Hood**

Material flow analyses show where your waste came from and where it is going. Waste characterization analyzes the composition of the waste stream to identify high volume waste categories and to target efforts to minimize, divert, and recycle the associated waste streams. We conducted more detailed waste characterization at some of the pilot installations. Fort Hood used the material flow analysis protocol that I discussed in the previous slide to collect data on the current waste generated and disposed. A waste characterization was conducted by examining and

categorizing waste streams as shown in the upper right of this slide. Fort Hood also performed a waste characterization of the material in their landfill as shown in the lower left of this slide. This characterization revealed that 48 percent of Fort Hood's landfill waste was recyclable included glass, metals, paper and plastic. An additional 13 percent of the landfill waste was organic materials that could potentially be composted. A material flow workbook was developed to compile and analyze material flow and waste characterization data. Material flow diagrams were constructed to better understand where the waste was coming from and where it was going. Using this information, Fort Hood could identify technologies and opportunities to reduce the generation of waste and increase the diversion of waste.

Periodic waste stream analysis enables an installation to establish its 'baseline' waste composition and to more readily target waste streams for elimination, minimization, or diversion. The DoD Integrated Solid Waste Management Policy recommends annual waste stream analysis as a best practice for installation solid waste management. Waste stream analysis can be accomplished using traditional 'sort and weigh' methods or less labor-intensive visualization methods. A combination of weighing/sorting and visualization may be ideal, if time and resources allow. In any case, the characterization should include building numbers and information about the 'generating activity' for each dumpster. Real Property facility/category codes or building occupant information can be used to determine the 'generating activity' for the waste in the dumpster. Analyzing the waste characterization information by similar 'generating activity' (e.g., clinics, food service, motor pools) may facilitate the installation's efforts to minimize, divert, and recycle the associated waste streams.

We will talk more about diversion in the next slide.

### **Slide 17: Material Flow - Divertability**

We developed a "divertability scale" for the Material Flow Analyses.

This enabled us to:

- identify existing recycling and diversion options that were underutilized
- identify new options that could be implemented without significant cost or effort
- and identify waste streams that needed a technology solution

The table on the upper left shows the "divertability scale". The lower left pie chart shows the diversion potential of the wastes.

The next slide shows divertability at Fort Bliss

### **Slide 18 Divertability at the Fort Bliss Hospital**

This is a material flow diagram from the Fort Bliss Hospital. It shows material inputs, as well as outputs and also shows where materials could be recycled or diverted. Identifying technology solution needs will also help us feed into the Army & DoD technology demonstration programs



Now let's look at a couple stellar examples from Fort Carson and Joint Base Lewis-McChord. Then we will move on to Best Practices that were published in the 2012 Net Zero Progress Report, the ASA(IE&E) website and collectively gathered for the Draft Net Zero Waste Best Practice Brochure.

### **Slide 19: Net Zero Waste – Fort Carson**

The Sustainable Fort Carson Program supports all IMCOM Campaign Plan lines of effort; improves energy security and decreases reliance on petroleum; reduces unnecessary impacts to training lands and restores habitat; reduces environmental compliance risk; eliminates waste; enhances human health, safety and well-being; conserves water for human and ecosystem needs; imparts a sense of community through land use planning; and finally it saves money! Under the Programs' umbrella, Fort Carson boasts a robust Recycle Program (a QRP) that proactively supports the installations' goal to achieve Net Zero Waste. The Operations and Maintenance Division of the Directorate of Public Works – or DPW – maintains a 24/7 Recycle Center and four (4) recycle drop-off locations.

To address the top of the Net Zero Waste hierarchy which is 'Reduction' they have a proactive sustainable procurement program, and are actively working with their procurement officers to improve purchasing practices.

In addition to the standard list of items accepted for recycling, Fort Carson is continually adding to that list through research and collaboration efforts. A regional non-profit takes furniture that would have otherwise been disposed of as waste and the City of Colorado Springs collects porcelain from Fort Carson and then crushes the would-be waste material to be re-used as aggregate, and they also contract with UNICOR on recycling options for personal electronics.

Fort Carson has found a way to address the monumental challenge of recycling mattresses. Fort Carson transports mattresses to a local recycling facility where the springs are removed and sold to another local recycler for the metal content. The remaining materials are shredded, compressed, baled, and placed in a covered accumulation area. Once 40,000 pounds have accumulated, the bales are shipped to a manufacturer for use as a raw material. Typical end-uses include carpeting and insulation.

The Recycle Program recently initiated a Recycle Incentive Barracks Single Stream (RIBSS) Program geared towards getting Soldiers involved in recycling and earning money for morale, welfare and recreation funds for barracks. Units bring their recyclables to the Fort Carson Recycle Center to be weighed and have their accounts updated.

An Environmental "Battle Book" shows materials/products used on Fort Carson and provides turn-in procedures for those items that can be recycled or re-purposed. The Fort Carson Facility Managers (FM) Handbook specifically defines Net Zero responsibilities not only for Facility Managers, but for units, Directorates and tenants. Facility Managers support recycling efforts in their building(s). Military Facility Managers encourage their Soldiers to participate in the Recycle Incentive Barracks Single Stream Program and conduct spot checks to ensure unit compliance with recycling policy.

## **Slide 20: Net Zero Waste – Joint Base Lewis McChord Case Study: JBLM concrete/asphalt recycling and compost facility**

Joint Base Lewis-McChord or JBLM is the third largest Army installation with a community of approximately 100,000 people, including Soldiers, Airmen, Family members, civilian workers, and retirees within 50 miles of JBLM. In 2002, JBLM emerged as a leading force in sustainability when it became one of the first Army installations to implement a sustainability program. Joint Base Lewis McChord (formerly Fort Lewis and McChord Air Force Base) is both a Net Zero Water and Net Zero Waste installation.

This Case Study focused on the Joint Base Lewis McChord Recycling Center also referred to as “Earthworks”. The JBLM Recycling Center is part of the Sequelitchew Creek EcoPark and Earthworks project – a redevelopment of a former landfill (Landfill #5) into a nature preserve and organics recycling center. Redevelopment activities began in 2005 and at completion the EcoPark will feature native prairie, forest and woodland communities that resemble pre-settlement conditions, wetlands, an education center, interpretive displays and a walking trail. Earthworks currently supports waste diversion, recycling and reuse operations through composting, concrete and asphalt recycling and wood waste recycling, and soil remediation projects.

Asphalt and Concrete Recycling began as mining activity when an inert concrete and asphalt landfill that occupied a portion of Landfill No. 5 was officially closed in 2008. Over 25,000 tons of waste concrete and asphalt was mined from this landfill and reused in a storm water management project. Since that time the on-going practice is to collect aggregate from small projects at JBLM and store at Earthworks until the material has been grinded down for re-use – see picture of the grinding operations on next slide.

JBLM implemented composting onsite for pre-consumer food waste, grass and landscaping, and 100% of bio-solids from the wastewater treatment plant.

Both of these best practices keeps soil and construction and demolition aggregate materials from being hauled away and then re-purchased, and also saves transport costs, fuel, and emissions. JBLM found that the cost of using reclaimed material is dependent on the volume of material processed, but is generally less than 50% of the cost of virgin material. So the installation is increasing recycling and composting.

I will provide more details on both activities in the next two slides

## **Slide 21 Case Study: JBLM concrete/asphalt recycling**

Joint Base Lewis-McChord collects and stockpiles waste concrete and asphalt generated from in-house projects. It then reclaims the material to provide high-quality, Washington Department of Transportation-specification aggregate for other on-post projects. The use of reclaimed aggregate qualifies for Leadership in Energy and Environmental Design or LEED credits, enabling JBLM to also

meet the Army's sustainable design and development policy for new construction and major renovations.

A third order benefit of this best management practice is a reduced carbon footprint. This on-Post reclamation effort eliminates the inbound and outbound trips to offsite disposal and virgin product quarries, significantly reducing greenhouse gases associated with aggregate transportation, as well as the volume of traffic through JBLM's access gates.

The pie graph on this slide shows that in FY2013 the largest categories of recycling material that were stockpiled for future use was concrete, asphalt, and clean soil from construction projects. A new highway project that has been planned for years but suspended until funded (the Cross base highway) is projected to use 100,000 cubic yards of this stockpile, earning Joint Base Lewis-McChord a projected cost **avoidance of over \$2 million**.

Next we will look at the composting operations co-located with the asphalt and concrete recycling activity at Earthworks.

### **Slide 22. Case Study: JBLM compost facility**

We discussed JBLM's practice of stockpiling waste concrete and asphalt and then reclaiming the material to provide high-quality aggregate. Another best practice of JBLM is turning organic waste resources into valuable landscaping and soil amendment products. Between FY 2006 and 2011 JBLM diverted approximately 29k tons of organic wastes such as leaves, grass, food waste, landscaping and land clearing debris, storm debris, stable waste, and biosolids from off-installation landfill disposal and recycling facilities. A conservative estimate of cost savings is approximately \$2.65M. Since 2006, The JBLM Compost Facility has produced over 12k tons of compost products with an estimated value of \$200k. The JBLM Compost Facility product is used either on base or sold via public auction. In 2012 JBLM compost was certified by the US Composting Council Seal of Testing Assurance program. This certification is the gold standard for compost product in the United States. Composting organic wastes at JBLM has proven to be an economically sustainable investment and has evolved into a 'community connector'. JBLM's composting operation serves as a model not just for other Army installations but for students and teachers of the Washington Organic Recycling Council's Composting Operators Course, who tour the facility regularly.

Recently JBLM performed an evaluation of compostable biobased food service ware which may enable them to consider composting post-consumer food waste from their dining facilities. Typical post-consumer food waste is contaminated with plastic and foam food service ware such as disposable bowls, containers and cutlery that prevents the waste from being composted. The implementation of biobased compostable food service ware would enable them to compost both the food waste and the food service ware.

In 2012 JBLM sold the largest pile of compost ever sold through the government's surplus liquidation site – over 5 million pounds for approximately \$9,000. The JBLM Composting Facility has operated

successfully since 2006 and in 2011 an expansion doubled its capacity to meet the present and future needs of JBLM in support of the Army's vision of "Net Zero Waste by 2020".

Now we will discuss another Net Zero Waste Pilot success – Fort Polk Battery Charging and other best practices

### **Slide 23. Success Story Fort Polk Battery reuse- BP published on Army website**

The aggressive training mission of the Joint Readiness Training Center (JRTC) at Fort Polk, Louisiana presents significant challenges to pursuing Net Zero Waste without impacting the mission. The JRTC provides highly realistic, stressful, joint and combined arms training for units in 3 week rotations, leaving little time for clean-up following the exercise, even less for the management required of the 12-volt lithium batteries (BA 5590 and BA 5390) used during their rotations. Each year units turn in about 7,300 of these batteries at the end of their 3 week training at the JRTC, nearly half of which are still usable (70% of battery's life span remaining). Seeing an opportunity to reduce battery expenditures, waste disposal costs and potential injury to soldiers, JRTC and Fort Polk personnel developed a program for the turn-in, testing and re-issue of these batteries. Testing the batteries to determine life-span requires special equipment employed by personnel specifically trained in safely discharging and operating the testing equipment. Re-issue of the BA 5590 and BA 5390 lithium batteries has resulted in an annual cost savings to the Army of over \$450k. Additionally, environmental compliance, waste reduction, and worker health and safety have also improved.

Other best practices identified at Fort Polk include the following:

- Rather than spend \$40,000 to dispose of three storage containers filled with empty fire extinguishers, DOL personnel cut the extinguishers, creating scrap metal that was sold for \$3,000.
- When government-issued cell phones are returned to the Network Enterprise Center (NEC), the NEC reissues them if they are in good shape.
- When possible, unusable furniture is taken to the QRP and, as necessary, disassembled by hand, allowing metal to be captured for recycling.
- Fort Polk requires vendors to take back packaging from new furniture deliveries.
- Since 2009, Fort Polk's Barracks Furniture Manager has been purchasing foam mattresses in place of traditional mattresses to extend the life expectancy to 5 years, permit better cleaning, and provide opportunities for recycling of the resource at the end of its life.

We continue with the best practices identified in the 2012 Net Zero Progress Report on the next slide.

### **Slide 24: Net Zero Waste Best Practices 2012 Progress Report**

The purpose of the 2012 Net Zero Progress Report on the Army's Net Zero Pilot Installation Initiative was to provide a summary of the progress to date and delineate the next steps to institutionalize Net

Zero Army-wide. The report, released in May of 2013, also identified the following Net Zero Waste best practices:

#### Establish a Qualified Recycling Program

Every Army installation should establish a Qualified Recycling Program (QRP). At its most basic level, a QRP enables the installation to receive and utilize the proceeds generated from its scrap metal sales via their servicing Defense Logistics Agency Disposition Services (DLADS) office. This level of QRP can be established without additional staff, facilities, or equipment; however, the scrap metal proceeds can then be used to expand the installation's recycling program to collect and sell other recyclables (e.g., aluminum, cardboard) where cost-effective, based on available local and regional markets. The QRP also benefits the installation's Morale, Welfare, and Recreation programs.

Many Army installations have implemented successful recycling programs via a QRP, and have utilized their QRP proceeds to increase the variety of materials collected for recycling, in turn increasing their recycling rates. QRP proceeds can be utilized to purchase additional recycling equipment and establish incentive programs, such as recycling contests between military units and organizations. Recent waste characterization studies show that the recyclable content of installation waste streams can still be high even at installations with the most mature recycling programs.

#### Characterize and Quantify Waste Streams

Periodic waste stream analysis enables the installation to establish its 'baseline' waste composition and to more readily target waste streams for elimination, minimization, or diversion. The DoD Integrated Solid Waste Management Policy (1 Feb 2008) recommends annual waste stream analysis as a best practice for installation solid waste management. Waste stream analysis can be accomplished using installation personnel or via contractor support, using traditional 'sort and weigh' methods or less labor-intensive visualization methods. A combination of weighing/sorting and visualization may be ideal, if time and resources allow. In any case, the characterization should include building numbers and information about the 'generating activity' for each dumpster. Real Property facility/category codes or building occupant information can be used to determine the 'generating activity' for the waste in the dumpster. Analyzing the waste characterization information by similar 'generating activity' (e.g., clinics, food service, motor pools) may facilitate the installation's efforts to minimize, divert, and recycle the associated waste streams.

#### Implement Sustainable Purchasing Practices to Reduce Waste at the Source

Source reduction is the highest level of the Net Zero Waste hierarchy and should be the first course of action in reducing the installation's waste stream and specific materials within it. Improved purchasing practices can significantly reduce the volume and type of waste generated on Post. For example, supply contracts can be revised to minimize packaging waste, require compostable packaging materials (e.g., Fort Polk's 'say no to Styrofoam' campaign), or include 'take back' clauses for categories of packaging (e.g., pallets, expanded polystyrene). 'Take back' efforts have been

successfully implemented in Europe for a wider variety of items beyond packaging, including appliances, modular office components, and tires. Whenever feasible, installations should utilize bulk purchasing to minimize waste generation.

We continue with the best practices identified in the 2012 Net Zero Progress Report on the next slide.

### **Slide 25: Net Zero Waste Best Practices 2012 Progress Report cont.**

#### **Leverage Low-/No-cost Reuse Opportunities**

Many reuse and repurposing opportunities require a minimal amount of time and coordination, and are free or low-cost. Numerous opportunities for greater repurposing and reuse can be found in all activities across the installation, and several common best practices have emerged.

- Furniture is a major waste stream with high potential for reuse. Installations have partnered with their servicing Defense Logistics Agency Disposition Services (DLADS) office, established dedicated storage space, and developed procedures for providing the furniture for on-post reuse. Other installations are donating end-of-life furniture to off-post nonprofit organizations when on-post uses have been maximized and DLADS is not able to process the furniture.
- Food waste is another major waste stream on Army installations, with high potential for diversion. To address part of the food waste stream, some installations have partnered with local nonprofit organizations and/or waste haulers to donate recently-expired food from commissaries and end-of-the-service-day food from service providers.
- Recovery and diversion of usable building components prior to building deconstruction/demolition is another best practice that can be implemented for little to no cost. Fort Hood has worked with Habitat for Humanity to recover building components. Other installations have implemented similar efforts with non-profit organizations.

These examples show that reuse and repurposing can be a low-cost form of waste diversion when personnel invest the time to coordinate and develop the opportunities. Installations are finding and implementing more and more initiatives as a part of their Net Zero Waste efforts.

#### **Leverage Low-/No-cost Recycling Opportunities**

Most installations have basic recycling programs for the traditional recycling streams (e.g., scrap metal, aluminum, cardboard, paper, plastics, glass), operated either through on-post programs (e.g., a QRP) or their local solid waste hauler. Low-/no-cost opportunities to expand the installation's recycling options may be available from unexpected sources. Personal electronics recycling has been implemented at many installations through partnerships with vendors such as UNICOR, which responsibly recycle and dispose of the electronic components. Collection events are held on post to collect personal electronics and some vendors, including UNICOR, will take the items for free. Fort Carson participates in the City of Colorado Springs' end-of-life porcelain recycling.

I will now summarize the Net Zero Waste Best Practices that were collected and documented as a result of the three plus years in working with the pilots

### **Slide 26: BP – Expand recycling program**

For the next few slides I will share other Net Zero Waste Best Practices. These have been documented in working with the pilot installations over the past three plus years.

I will start with a best practice that contains many elements: Expand Existing Recycling Program. All Army installations are required to have a recycle program in place and it was identified as a best practice at the onset of the Army's Net Zero Initiative to establish one as a Qualified Recycle Program (QRP). This slide lists best practices that will enhance or add focus to an installations recycle program or QRP.

1) Add to the list of recycled materials, particularly less common but still valuable items (e.g. 3-7 plastics), and find new vendors as needed. 2) Identify opportunities to utilize Single Stream Recycling, e.g. food courts, family housing, events, and military training areas. 3) Decrease contamination of waste stream through new sorting procedures and equipment. 4) Upgrade other processing equipment, such as shredding, baling and sorting. 5) Increase storage, particularly for less common or less valuable materials. 6) Promote new initiatives that leverage the participation of other organizations (but are still tracked through the Qualified Recycling Program (QRP), such as drop-offs from tenant organizations. 7) Manually remove recyclable items from the waste stream when waste is being centrally collected or sorted already.

I will continue with best practices installations can adopt to improve and expand their Net Zero Waste program.

### **Slide 27 Expand Recycling**

The following best practices have been identified to promote recycling and increase recycling rates

Bring Your Own Bag Campaigns - Plastic disposable shopping bags are a major source of film plastic waste on installations. Following the Net Zero Waste hierarchy, the reduction of this waste stream should first be addressed through source reduction. Substituting re-usable shopping bags, and promoting them through installation-wide campaigns, can effectively achieve source reduction.

Clean and Re-Use Shop Rags - Shop rags represent a large textile waste stream at many installations. As a source reduction action, and because textile waste is very difficult to divert from the landfill, cleaning and re-using shop rags is a best practice. Typically, a contract is arranged with a vendor, and the cleaning and re-use of rags is offset by the costs savings on new shop rags.

Recycle Wrap - Woven polypropylene blue sterilization wrap can be recycled; this material is generated by the hospital and is a high value polymer.

Substitutes and re-use of Packaging Materials - Packaging is a broad category of material that makes up a significant portion of an installation's total waste, and so has been identified as a high priority waste stream. Within this category, many opportunities exist to re-use, eliminate or find substitutes for this priority waste stream. For example, Expanded Polystyrene Foam (Styrofoam™), Insta-Pak™ foam, and film plastics can be recycled using densification equipment, re-used or replaced with paper or cardboard substitutes and some film plastics can be reduced or eliminated depending upon packaging design.

Re-Use of Textiles and Linens (particularly in medical activities) - When textiles are lightly soiled (e.g., from ink stains), they can be dyed to obscure the stains. Linens can be repaired until they cannot be used anymore, then donated to be repurposed (e.g., rags, veterinary clinics and animal shelters). This relates to the Net Zero hierarchy in the areas of reduction and repurpose. Disposal of scrubs can be reduced by having the stains dyed so that the medical community can re-wear them or repurposed by using them at veterinary clinics on Army installations.

Setting Printers to Double-Sided Printing - Setting printer defaults to double-sided printing is now a standard procedure in many large private sector and government organizations. Printing double-sided can prevent an estimated 61 billion sheets of paper from entering the waste stream annually—government wide, an excellent example of source reduction – the top priority for an Army installation's approach to Net Zero Waste.

I will continue with Net Zero Waste Best Practices on the next slide

### **Slide 28 Expand Recycling cont.**

Co-locate Recycling Bins - Placing recycling bins next to waste bins is crucial for successful source separation. Numerous studies have concluded that the proximity of recycling containers to refuse containers has a substantial impact on recycling and diversion rates.

Establish Recycling Challenge Programs and Contests - A portion of an installation's QRP proceeds can be used to challenge one unit to recycle more than another unit, and receive funds and other rewards. So far, this approach has been proven a best practice for increasing awareness of Net Zero Waste and potentially fostering a culture change in behavior as it reinforces a sustainable mindset across the installation by providing rewards for units to prevent recyclable waste from going to the landfill.

Performance-Based Contracting for Solid Waste and Recycling Collection - Use performance-based contracts for solid waste collection, particularly if the same vendor provides solid waste and recycling services. Develop new language for solid waste and recycling collection contracts that require service providers to weigh each dumpster before emptying, record waste data, and provide data to the installation. Contracts should provide financial incentives to vendors that increase the diversion of waste from landfills and/or incinerators. Note: weighing solid waste and diverted material containers is essential for this type of contract to work. This will help the installation acquire better data on their



refuse rates and help to pinpoint the largest generators of refuse to address first in their plans to achieve Net Zero Waste.

Social Media: Installations may be able to leverage existing outreach efforts by providing Net Zero focused information and engagements. Social media, newspaper articles, workshops, recycling events, fliers, posters, and mock-billing programs are all examples of what pilot installations have been doing to support their Net Zero efforts.

I will discuss the final category of Best Practices – Pilot Programs and Demonstration and Validation – or Dem/Val Projects.

### **Slide 29 Best Practices Pilot Programs**

Another best practice is the use of pilot programs and demonstration projects as a potential venue to support efforts toward Net Zero Waste. As discussed in the previous Net Zero training modules, before new technologies are deployed across an installation and ultimately verified as a 'Best Practice' they are often demonstrated on a smaller scale through pilot programs and demonstration and validation (Dem/Val) projects. Pilot programs may involve new technologies or working with new partners. The focus is on temporarily implementing a new approach or technology, or leveraging external stakeholders with similar interests, to provide an opportunity to document the full effects of the actions on Net Zero goals before it is more permanently adopted.

Pilots and Dem/Vals for the most part, deal with emerging new technologies; technologies too new to be accepted as an established Best Practice at an Army installation. Pilots and Dem/Vals are implemented with the intention that if successful, ultimately the subject of the pilots will be established as a Best Practice as depicted on the slide. The point at which a pilot program or Dem/Val is raised up to a Best Practice is determined on how widely it is adopted and successfully implemented.

Pilot programs, such as the Net Zero Pilot Installation Initiative or the Fort Carson Net Zero Building Pilot can potentially raise awareness about Net Zero Waste and foster a culture change that leads to increased recycling and source reduction. Dem/Val projects that support Net Zero Waste might include new waste-to-energy technology that is in line with the Net Zero Waste hierarchy in regards to energy recovery and source reduction.

We continue with this discussion on the next slide.

### **Slide 30 Best Practices Pilot Programs**

Electric Hand Dryer Pilot Program - Based on research provided in FY2012 by the Army Environmental Command, installations have shown a greater interest in electric hand dryers. Although sanitation is still somewhat of a concern with electric hand dryers, a pilot study with "touch-less" electric hand dryers may support further use of them.

Food Waste Donation with External Organizations - With the support of installation legal personnel, food waste donation programs have been established at installations through partnerships with

community “food rescue” and food bank organizations. This is more of an example of a best practice that hasn’t yet been practiced enough. But, this has the potential to address a huge waste stream on Army installations. In the spirit of Net Zero, installations are encouraged to research and investigate any viable means at which they can legally work with ‘food rescue’ groups and food bank organizations. The Department of the Army, Army Food Donations Procedures Memorandum strengthens the Army’s commitment to food donation programs and establishes procedures for providing excess food to food recovery and distribution organizations.

RecycleMatch Demonstrations - Leverage regional differences in recycling infrastructure. The ability to recycle materials depends on the local and regional capabilities of recyclers to accept and process materials. RecycleMatch is an open market software tool that allows installations to put materials up for bid and allows installations to leverage different regional capabilities for recycling. Preliminary feedback from the ongoing demonstration shows that RecycleMatch provides the most benefit to installations with hauling and baling capabilities at their QRP.

Manufacturer Take-Back Programs - Although manufacturer take-back programs are growing widely in Europe and the United States, the Army has only begun to implement this type of program. Installations have worked successfully with manufacturers of furniture to take back packaging materials and re-usable pallets.

This discussion continues on the next slide.

### **Slide 31 Best Practices Pilot Programs**

Dining Facility **Pre-Consumer** Food Waste Pilot Program - Several installations have found that diverting pre-consumer food waste is one of the most practical diversion opportunities for the significant amount of organic waste in installation waste streams. Installations are now identifying the best composting systems and digesters that can efficiently divert this waste stream (see next four slides for more information).

Dining Facility: **Post-Consumer** Food Waste. Dining facilities generate a large amount of post-consumer food waste. As previously discussed in the JBLM slide, challenges with composting post-consumer food waste include waste segregation from non-compostable materials such as plastic or foam food service ware products. Other challenges include collection and handling and the potential for transmitting pathogens which can be avoided with safe handling procedures. The use of compostable biobased food service ware items can reduce separation requirements. Some municipalities such as the City of Seattle accept post-consumer food waste in their curbside compost collection. In addition, many universities and athletic stadiums are implementing compostable food service ware to allow composting of their waste. Compostable food service items should be demonstrated to determine their performance in the dining facilities and their compostability in the installations composting process.

Food Waste Digesters, Dehydrators, and In-Vessel Compost Systems - Because many installations are now focusing Net Zero Waste efforts on their food waste streams, installations can collectively

benefit from demonstrations of various technologies that can efficiently divert food waste (and other biodegradable organics materials). Technologies that should be demonstrated and evaluated include digesters, dehydrators, and in-vessel compost systems. Some of the technologies should also be demonstrated in different bioregions.

Anaerobic Digesters - Although anaerobic digestion is not a new technology and has been used on a large-scale basis in wastewater treatment, the use of the technology should be demonstrated with other biodegradable materials.

Composting Methods and Technologies - Open static pile and covered aerated static pile methods of composting have been demonstrated at Army installations and are gaining in popularity. The Army has published guidance on composting and this has resulted in increased use of this approach to address Net Zero Waste. We continue with the discussion of composting technologies on the next four (4) slides focused on the studies conducted by the US Army Engineer Research and Development Center or ERDC.

### **Slide 32 Vermi Posting – ERDC Pilot Study**

This slide and the next three showcase composting technologies as published by the US Army Engineer Research and Development Center. Mention of specific products or manufacturers does not imply endorsement by DoD, the Army or ERDC. We begin with Vermi-posting.

Many schools use this technology as part of their environmental curricula and lesson plans are well developed for this educational activity. This would work well for on-post schools or as part of a Morale, Recreation and Welfare (MRW) after school activity. On-Site and Near-Site placement minimizes transportation costs. Carbon source/bulking agent refers to paper, cardboard, wood chips or landscape waste.

There are larger scale worm farms in use in Europe and India.

### **Slide 33 – Food Digesters - ERDC Pilot Study**

There are several types of food digesters, ranging from home usage varieties to industrial scale models. We will focus on the industrial or institutional types of commercial food waste digesters. Food waste is completely broken down and turned into an organic rich effluent that can be disposed of in the sewer system or captured and used as gray water or compost tea for landscape irrigation. Note that this aspect has not been subjected to focused scientific research and that the effluent may require additional treatment before use as landscape irrigation. Again, mention of a specific trade name or manufacturer does not imply endorsement by the DoD, Army, or ERDC

### **Slide 34 – Food Waste Pulpors- ERDC Pilot Study**

Water use for pulping is minimized through recycling and reused during pulping process.

- pulp is first separated from waste

- Results in a significant volume of waste reduction
- Dried pulp typically is landfilled (including paper and plastics)
- Potentially, the pulp could be land applied as soil amendment if no contamination (plastics, glass) exists

As you will see in the Lesson's Learned slide further below, one installation did not have success with using a paper making by-product as a soil amendment, but further research is on-going.

### **Slide 35: In-Vessel Aerobic Systems- ERDC Pilot Study**

Several installations have found that diverting pre-consumer food waste is one of the most practical diversion opportunities for the significant amount of organic waste in installation waste streams. Installations are now identifying the best in-vessel composting systems and digesters that can efficiently divert this waste stream

The In-Vessel Aerobic system is a good choice for a DFAC at an Army Installation or other institutional food service setting. The systems have proven to be efficient with short turnaround times.

Secondary carbon source bulking materials consist of paper, cardboard, wood chips, landscape waste.

The systems can process between 1,000 and 10,000 pounds of food waste in a week. There are numerous manufacturers capable of custom design to meet waste stream specifications. The "Ag-Bag" system is one example and offers several types like:

- Stationary in-vessel
- Containerized in-vessel
- Covered , aerated static piles and towers
- Rotating drums

In the next slide we will discuss collaboration – a key element of a successful Net Zero management approach

**Slide 36 Collaboration** is the cornerstone of the Net Zero Pilot Installation Initiative, The goal is for information learned at one Net Zero pilot installation to be shared with other Army installations.

The Net Zero team at the Headquarter-level hosts monthly collaboration calls and periodic progress meetings with representatives from our energy, water, and waste pilot installations and their Commands.

We have also partnered with other Federal agencies and with industry through public-private partnerships, and with municipalities and communities to develop mutually beneficial solutions at the local and regional levels.

Installations are also working with communities to develop local and regional solutions.

Fort Hood worked with the Central Texas Partnership Program to install a regional recycling option program that has returned over a \$100,000 dollars to the units in support of Family and Morale, Welfare and Recreation programs. Fort Hood is also working with Habitat for Humanity to deconstruct buildings versus demolition.

We have established cross-functional Net Zero teams to share and document success stories and lessons learned. Some of the success stories could become the next Army standard as we learn more about increased mission capabilities and cost avoidance achieved from Net Zero.

Our collective challenge is to adopt and embed these takeaways into standard activities across all installations.

Next I will go over a few lessons learned.

### **Slide 37 Lessons Learned**

Collaboration and teamwork is necessary to succeed. A large proportion of installation activities are managed by a small number of organizations, such as the DPW. To date, Net Zero fell to a few implementing organizations, which creates the perception that Net Zero is the responsibility of these few organizations and lessens accountability to the end user or waste-generating activity. Since achieving Net Zero will require action by all stakeholders across the installation (military units, supporting organizations, tenants, contractors, suppliers, and families), identifying the responsible activity is necessary for success.

- Goals should include specific timelines and shorter-term objectives along the way to the goals. Smart goals are specific, measureable, attainable, realistic, and time-bound.
- Before implementing a Net Zero project – determine the level of command support and adjust as necessary. It is important to define the stakeholders and build consensus. Stakeholder collaboration is essential to successfully building this consensus and ensuring ownership of Net Zero goals. The installation DPW may be the Office of Primary Responsibility (OPR) for Net Zero, but representatives from across the installation directorates need to be engaged in goal setting.
- Outreach, education and awareness campaigns can often have significant impact or may be essential to support the success of achieving net zero goals
- Changes in procurement or material management practices may help eliminate, reduce or facilitate reuse of waste generated at an installation.

Now we will discuss what Fort Polk learned about collaboration and byproducts.

### **Slide 38 Lessons Learned at Fort Polk**

Installation personnel at Fort Polk learned through a pilot project that a cellulose based by-product obtained from a local paper plant does not work as a soil amendment. Working in collaboration with

paper plant personnel in an effort to find a cost effective way to eliminate waste and create valuable and sustainable uses for byproducts, Fort Polk initiated the Cellulose Land Application Pilot Project.

Teaming with community and industry to utilize a paper making byproduct as a soil amendment, the cellulose byproduct was tilled into the soil followed by seeding and fertilizing.

The findings of the pilot project revealed that this type by-product did not work well as a soil amendment. The photos on this slide show the soil separation which does not facilitate plant growth and does not compact well. Efforts are underway to determine why the by-product did not help with vegetation growth.

The importance of collaboration has been reinforced through the relationships developed with local industry through the efforts of this project. The results should not discourage other installations to implement pilot projects or Dem/Vals but rather encourage trying new approaches and new technologies. Achieving 50% diversion rates at Army installations has been relatively easy; it's the next 50% that will be challenging and require a different approach or advanced technology.

### **Slide 39: Questions**

Thank you for tuning into Module 5 of the Net Zero online training Net Zero Waste.

Additional information on Net Zero and other Army energy and sustainability programs and policies is available on our office website.

Thank you for your attention.

## **APPENDIX F**

### **Net Zero Training Module 6 Net Zero Resources**



#### **Appendix F NZ Training Module 6 Res**



#### **Appendix F NZ Resources Module 6 S**

## **Appendix F**

***Task 0818, "Army Net Zero Prove Out  
Final Net Zero Training Report***



# Army *Net Zero*

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## Army Net Zero Training Module 6: Resources

Assistant Secretary of the Army  
(Installations, Energy &  
Environment)





# Module 6 – Resources

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- Target Audience and Learning Objectives
- Review Net Zero Training Modules 1 through 5
- Net Zero Energy Resources
- Net Zero Water Resources
- Net Zero Waste Resources
- Training Courses
- Links



# Modules 1 through 5

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- Module 1: Net Zero 101
- Module 2: Army Management Approach to Net Zero
- Module 3: Net Zero Energy
- Module 4: Net Zero Water
- Module 5: Net Zero Waste



# The History of Army Sustainability



## Why & Where it Started



**Installation Sustainability  
Program**

# Journeying Towards Net Zero



## Drivers

- Energy security, surety, and reliability
- Water scarcity
- Increasing energy prices/ Fully burdened costs of fuel
- Foreign energy sources
- Environmental concerns
- Federal and DoD mandates
- Improved operational capabilities
- Risk reduction

*Drivers for Change Resulted in Creation of Net Zero Programs for Energy, Water, and Waste*

## 17 Pilot Installations



## Evolution of the Hierarchy



# Net Zero Hierarchies



**Net Zero ENERGY:** Reducing overall energy use, maximizing efficiency, implementing energy recovery and cogeneration opportunities, and offsetting the remaining demand with the production of renewable energy from onsite sources, so that the Net Zero energy installation produces as much renewable energy as it uses over the course of a year.

**Net Zero WATER:** Reducing overall water use, regardless of the source; increasing use of technology that uses water more efficiently; recycling and reusing water, shifting from the use of potable water to non-potable sources as much as possible; and minimizing interbasin transfers of any type of water, potable or non-potable, so that a Net Zero Water installation recharges as much water back into the aquifer as it withdraws.

**Net Zero WASTE:** Reduce, reuse, recycle/compost, and recover solid waste streams, converting them to resource values, resulting in zero landfill disposal



# Pilot Implementation Activities



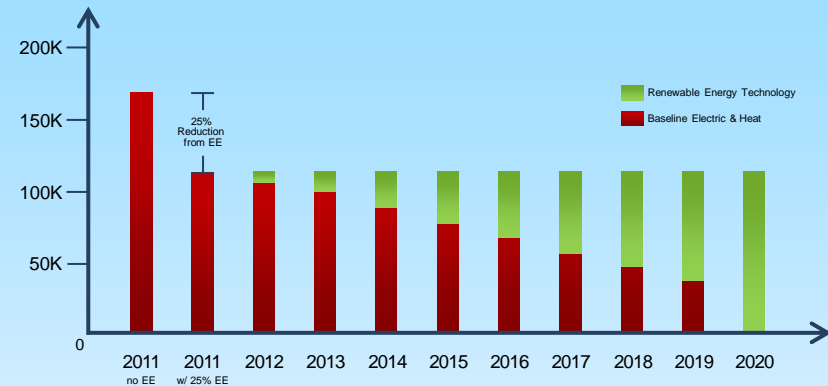
**Initiate:** Establish a baseline

**Assess:** Determine potential

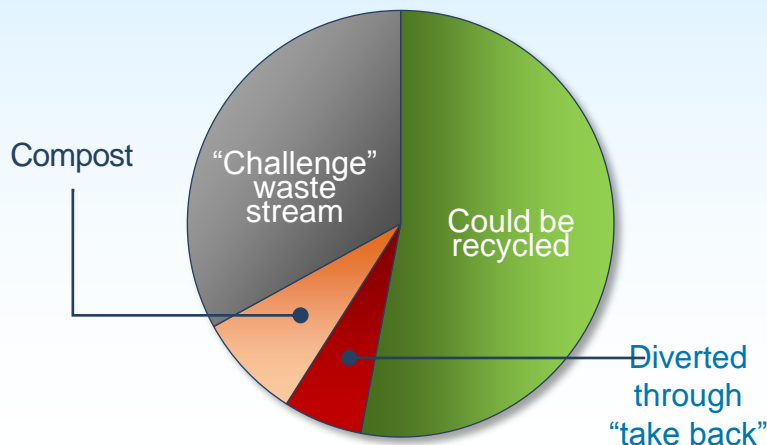
**Roadmap:** Plan and integrate the results into existing programs

**Implement:** Collaborate and act

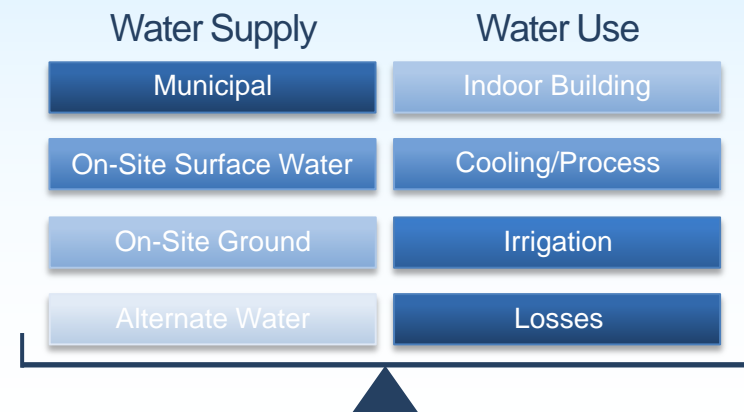
## Load Reduction and Renewable Energy Integration Roadmap



## Material Flow Analysis



## Water Balance Framework



# Steps in Net Zero Implementation



Installations  
should focus  
on the  
Planning  
Steps



2

**Plan**

STEP		ACTIVITIES
0	INITIATE	IDENTIFY AND ENGAGE KEY STAKEHOLDERS
		SET GOALS TO MEET PRIORITIES
		ESTABLISH SCOPE OF NET ZERO ACTIVITIES
1	ASSESS	CONDUCT ORGANIZATION AND DATA ANALYSIS
		EVALUATE CURRENT RESOURCE USE
		IDENTIFY OPPORTUNITIES AND NEEDS
<div>Plan</div>		DEVELOP AND EVALUATE NET ZERO ACTIONS
		PRIORITIZE NET ZERO ACTIONS
		VALIDATE PLAN
3	IMPLEMENT	ENGAGE ACTIVITY OWNERS
		IMPLEMENT PROJECTS
		MONITOR AND DOCUMENT RESULTS





# Water Scoring Activity - NDCEE



Ref ID	Net Zero Action	Water		
		(Mgal/yr water use reduction)/(baseline Mgal/yr water use)		
		Level	Calc	Comment
39W	Replace existing systems, such as bathroom fixtures, air handling units, irrigation controls with EPA WaterSense approved equipment	Less than 1%	0.279%	
40W	Acquire lower water-using systems (tactical and non-tactical): toilets and bulk purchase, composting toilets, and water-efficient wash-racks; base camps could be test locations for systems that could possibly be deployed to conserve and recapture water (implement policy/procedure)	Less than 1%	0.279%	
41W	Irrigation upgrades, landscape conversion, xeriscaping, other landscape water conservation measures	10% <= Impact < 30%	13.248%	based on Summary Table 6.1 in PNNL Roadmap
42W	Reclaim gray water from showers, dining facilities, and sinks and reuse in toilets or landscaping in accordance with applicable laws and regulations	Impact > 30%	279%	
43W	Capture lost water/re-direct water to other uses and reuse water where possible and economical	10% <= Impact < 30%	279%	
44W	ESPC #7 Includes purple pipe for the parade grounds and ball fields to use reclaimed water available from EPWU. Also includes irrigation system improvements and xeriscaping.	1% <= Impact < 10%	1.470%	Appendix E in PNNL Roadmap, projects 56 +59

Example of Water Scoring Activity. The drop down menu is depicted for NZA 41W. The user selects a range from this menu and this automatically assigns the score as well as the color coding.



# Life-Cycle Cost Effectiveness of Water Conservation Measures



- \$ High efficiency faucets and showerheads – very good
- \$ High efficiency toilets and urinals – poor
- \$ Efficient irrigation and native landscaping – marginal to poor
- \$ Industrial process improvements – good
- \$ Leak detection and repair – good to very good
- \$ Efficient kitchen equipment – marginal to good
- \$ Medical and laboratory equipment retrofits – good to very good

**List of  
common water  
conservation  
measures and  
typical life-  
cycle cost  
effectiveness  
as determined  
through  
PNNLs study**



# Renewable Energy Assessments



## ■ Process

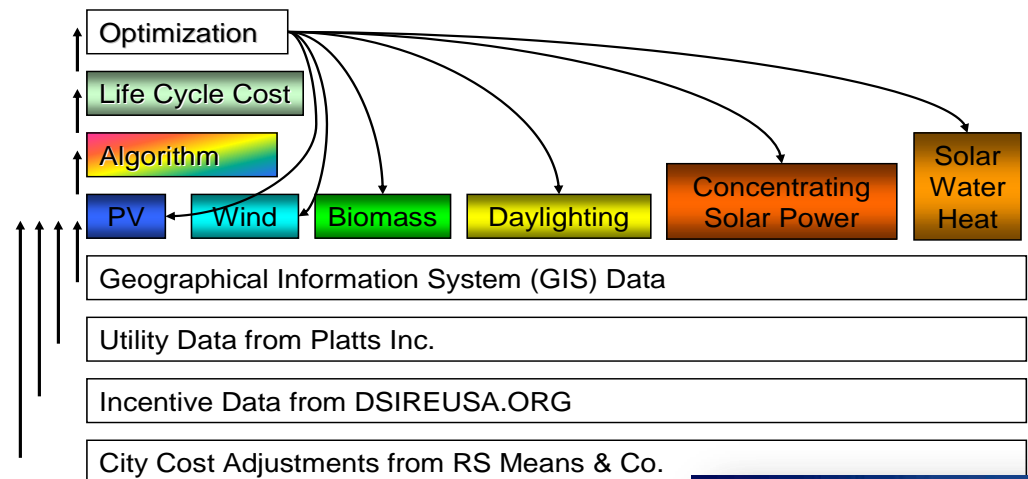
- ❑ Start with screening tools
- ❑ Conduct further analysis of promising technologies
- ❑ Make recommendations

## ■ Analysis tools

- ❑ GIS resource screening tools
- ❑ Renewable Energy Optimization (REO), PV Watts, In My Backyard (IMBY), RET Screen, Solar Analysis Model (SAM)

## Renewable Energy Optimization (REO)

- REO finds the least-cost combination of renewable energy technologies to meet net zero goal



National Renewable Energy Laboratory

11

## Considerations

Think outside the “standard tool” box → fuel cells, micro turbines, solar pools, etc.



# OEI Project Evaluation Criteria



**8 Assessment Criteria** should be reviewed regularly to identify and mitigate excessive risks and key issues for successful project development.

<b>Mission/Energy Security</b>	<ul style="list-style-type: none"> <li>• How does project enhance energy security on host and surrounding installations?</li> <li>• What are the possible impacts to Installation operations or tenant missions?</li> <li>• Has the project been approved by Installation, Army HQ, and DoD staffs?</li> </ul>
<b>Economics</b>	<ul style="list-style-type: none"> <li>• What is the estimate of the baseline capital cost?</li> <li>• What is the value of any RECs or other incentives?</li> <li>• What is the predicted resource? Has it been validated?</li> <li>• What is existing utility rate and alternative tariffs?</li> <li>• What are the impacts of the project to the POM?</li> </ul>
<b>Real Estate</b>	<ul style="list-style-type: none"> <li>• What is the Real Estate approach and what authority is being used?</li> <li>• Identify and mitigate real estate siting, constructability, access, or land use issues.</li> <li>• Is the project consistent with the Installation Master Plan?</li> </ul>
<b>Regulatory and Legal</b>	<ul style="list-style-type: none"> <li>• What are the regulatory limits for interconnection, net-metering?</li> <li>• What is the status of getting required PUC approvals?</li> </ul>
<b>Market/ Off-Take</b>	<ul style="list-style-type: none"> <li>• Will the installation consume all electricity generated?</li> <li>• What is the status of state RPS and other incentives to drive external demand?</li> <li>• If power is to be sold off the installation, have off-takers been identified?</li> <li>• Can the utility wheel power to other potential off-takers?</li> </ul>
<b>Technical/ Integration</b>	<ul style="list-style-type: none"> <li>• Is there sufficient line and substation capacity? What upgrades are required?</li> <li>• Are flow studies are required? What is the status?</li> <li>• Is the system upgradeable for smart grid and energy storage technologies?</li> </ul>
<b>Environmental</b>	<ul style="list-style-type: none"> <li>• What are the major environmental issues?</li> <li>• During the project lifecycle, which parties will perform ECP and NEPA requirements, and when?</li> </ul>
<b>Procurement</b>	<ul style="list-style-type: none"> <li>• What is acquisition strategy and timeline to implement?</li> <li>• What performance risks are there with the developer or other partners?</li> </ul>



# NREL's Models and Tools



## Technology and Performance Analysis



### **PVWatts**

Estimates the electricity production of a grid-connected roof- or ground-mounted photovoltaic system based on a few simple inputs.



### **The Energy DataBus**

Open-source software that collects massive amounts of energy-related data at second-to-second intervals.



### **Building Life-Cycle Cost (BLCC)**

Analyze capital investments in buildings. Includes the [Energy Escalation Rate Calculator](#) 2.0-13.



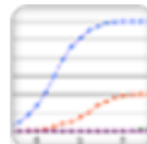
### **EnergyPlus Simulation Program**

Helps building designers and owners save money, reduce energy use, and improve indoor air quality.




### **Geothermal Prospector**

Designed to provide easy access to geothermal resource datasets and other data relevant to utility-scale geothermal power projects.



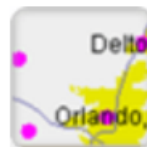
### **Solar Deployment System (SolarDS)**

Examine the market competitiveness of solar PV technologies from the building user's perspective. Contact [Paul Denholm](#) or read [documentation](#)  for more information.



### **Solar and Wind Energy Resource Assessment (SWERA) Model**

Use NREL's geospatial toolkit to visualize solar and wind resource data in 13 developing countries. Contact [Dan Getman](#) for more information.



### **Scenario Evaluation, Regionalization and Analysis (SERA)**

Determine optimal production and delivery scenarios for hydrogen, with this geospatial and temporal infrastructure analysis model.



### **Biomass Scenario Model (BSM)**

Determine which supply chain changes would have the greatest potential to accelerate the deployment of biofuels.



### **Theoretical Ethanol Yield Calculator**

Calculate the theoretical ethanol yield of a particular biomass feedstock, based on its sugar content.

[http://www.nrel.gov/analysis/models\\_tools.html](http://www.nrel.gov/analysis/models_tools.html)



## Energy Systems Analysis



### [Interactive Mapping Tools](#)

Access RE Atlas, Solar Power Prospector, PVWatts, and other popular tools that dynamically generate maps of renewable energy resources.



### [Regional Energy Deployment System \(ReEDS\)](#)

NREL uses this multi-regional, multi-time period, GIS and linear programming model of U.S. electric sector capacity expansion to analyze critical issues in the electric sector.



### [HOMER](#)

Evaluate design options for both off-grid and grid-connected power systems for remote, stand-alone, and distributed generation applications. HOMER is licensed to and maintained by Homer Energy.



### [Buildings Industry Transportation Electricity Scenarios \(BITES\)](#)

See how changes in energy demand and supply by economic sector can impact carbon dioxide emissions.



### [REFlex](#)

NREL uses this dispatch model to evaluate renewable generation as a function of system flexibility, and enabling technologies like demand response. Contact [Paul Denholm](#) for more information.



### [Stochastic Energy Deployment System \(SEDS\)](#)

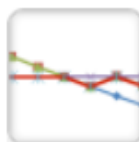
NREL uses this capacity-expansion model of the U.S. energy market to conduct deterministic or stochastic analysis.

## Economic and Financial Analysis



### [Job and Economic Development Impact \(JEDI\) Model](#)

Use these easy-to-use, spreadsheet-based tools to analyze the economic impacts of constructing and operating power generation and biofuel plants at the local and state level.



### [Cost of Renewable Energy Spreadsheet Tool \(CREST\)](#)

Assess solar, wind, or geothermal projects, design cost-based incentives, and evaluate the impact of tax incentives or other support structures with this cash flow model.



### [PV JEDI](#)

Estimate the economic impacts of constructing and operating photovoltaic power generation at the local and state levels.



### [System Advisor Model \(SAM\)](#)

Make performance predictions and cost of energy estimates for grid-connected power projects based on system design parameters that you specify.

[http://www.nrel.gov/analysis/models\\_tools.html](http://www.nrel.gov/analysis/models_tools.html)

# FEMP Technology Deployment Matrix



Rank	Technology	Application	Description	Key Factors to Consider
<b>Building Envelope</b>				
6	High R-Value Windows	Most building categories	Highly insulating windows triple pane R5 or greater (U value 0.22 and lower) windows	R-5 windows available - DOE has a volume purchase program. The DOE research goal is an R-10 window.
14	Cool Roofs	Most building categories	Cool roofs—roofs that stay cool in the sun by minimizing solar absorption and maximizing thermal emission—lessen the flow of heat from the roof into the building, reducing the need for space cooling energy in conditioned buildings. Cool roofs may also increase the need for heating energy in cold climates. For a commercial building, the decrease in annual cooling load is typically much greater than the increase in annual heating load.	Climate issues can affect performance. More beneficial in warmer climates. Some heating energy increase in colder climates. Lower impact if the roof has more insulation. The Secretary of Energy directed all DOE offices to install cool roofs, whenever cost effective over the lifetime of the roof, when constructing new roofs or replacing old ones at DOE facilities. He also encouraged other federal agencies to do the same.
17	Window films	Most building categories	A spectrally selective film used to decrease heat gained through a window	Window orientation is a factor in performance
33	Colored Paint for Heat Reflective or Absorptive	Most building categories	New technology allows for paint to be any color in the visible spectrum, yet have either absorptive or reflective properties in the heat spectrum.	A typical application would be to reduce the heat load on a wall receiving significant solar insolation.
47	Green Roofs	Most building categories with higher roof to conditioned floor area ratios.	Vegetation on the roof reduces heat load and adds insulation to the roof. Reduces storm runoff from roof.	Climate issues can affect performance. Greater weight loading on the roof.
48	Aerogel Insulation - Piping, Ducts, and Buildings	Most building categories	Aerogel products displace current insulation material. As the thermal conductivity of the aerogels is so low, aerogel insulation tends to be far thinner than current insulation.	Higher price than other insulations. Special applications such as translucent wall panels.
49	Smart Windows	Most building categories	Electrochromic glass uses electrical energy to transition between clear and darkened states. Darkened glass transmits less light and reduces heat gain when darkened, especially in dual pane windows.	Window orientation a factor in performance
<b>Water Heating</b>				
11	Condensing Water Heaters - Gas	Most building categories with tank type water heaters	Gas water heater that condenses water out of the flue gas to achieve higher efficiencies	FEMP Procurement regulations require Federal agencies to purchase commercial gas storage water heaters with an efficiency of 94% or greater when they have an input of 75,000 Btu/h or greater. Effectively this means it must be a condensing water heater.
<div> <span>Introduction + Description</span> <span>Summary</span> <span>Overall Ranking</span> <span>Tech by Category</span> <span>General Info</span> <span>Resources</span> <span>Ranking Criteria</span> </div>				

<http://energy.gov/eere/femp/downloads/femp-technologies-deployment-top-20>



# The Federal Energy Management Program's First Thursday Seminars



**FEMP FIRST THURSDAY  
SEMIN@RS**

December 4, 2014 1:30-3:00PM ET

**O&M Best Practices  
for Small-Scale PV Systems**

0.2 CEUs

**FEMP**  
Federal Energy Management Program

[https://www4.eere.energy.gov/femp/training/?keyword=&tid\\_3\[0\]=31](https://www4.eere.energy.gov/femp/training/?keyword=&tid_3[0]=31)



# EPA's Energy Star Portfolio Manager Sustainable Buildings Checklist



The screenshot shows the 'Complete the Sustainable Buildings Checklist' page in the Energy Star Portfolio Manager. On the left is a navigation tree with categories like 'Employ Integrated Assessment, Operation, and Management Principles', 'Optimize Energy Performance', 'Protect and Conserve Water', 'Enhance Indoor Environmental Quality', and 'Reduce Environmental Impact of Materials'. The 'Team' option under the first category is selected. The main content area shows the 'Guiding Principle: Team' section, which includes a description, radio buttons for 'Yes', 'No', 'In Process', 'Not Assessed' (which is selected), and 'Not Applicable (N/A) - Justification Required'. There is a link to 'View References & Resources'. Below this is the 'Supporting Documentation' section with checkboxes for 'Team roster or equivalent', 'Completed "Responsible Team Member" fields', and 'Other'. Another link 'Upload and View Documents on File' is present. The 'Responsible Team Member' section has a text input field for 'Enter Name'. At the bottom is a large 'Notes/Comments' text area. Navigation buttons at the bottom include '<< Back', 'Save & Close', 'Save & Continue >>', and 'Cancel'.

**Complete the Sustainable Buildings Checklist**

**Guiding Principle: Team**

Use an integrated team to develop and implement policy regarding sustainable operations and maintenance.

☐ Yes [View References & Resources](#)

☐ No

☐ In Process

☒ Not Assessed

☐ Not Applicable (N/A) - Justification Required

**Supporting Documentation**

☐ Team roster or equivalent

☐ Completed "Responsible Team Member" fields

☐ Other

[Upload and View Documents on File](#)

**Responsible Team Member**

Team Member:

**Notes/Comments:**

[<< Back](#) [Save & Close](#) [Save & Continue >>](#) [Cancel](#)

Use the Checklist to:

- Conduct initial and final building walkthrough assessments
- Track and easily view progress on each guiding principle
- Upload compliance documents to the repository for record keeping
- Create a portfolio-wide sustainability roll-up report
- Review up-to-date energy and water metrics generated by Portfolio Manager

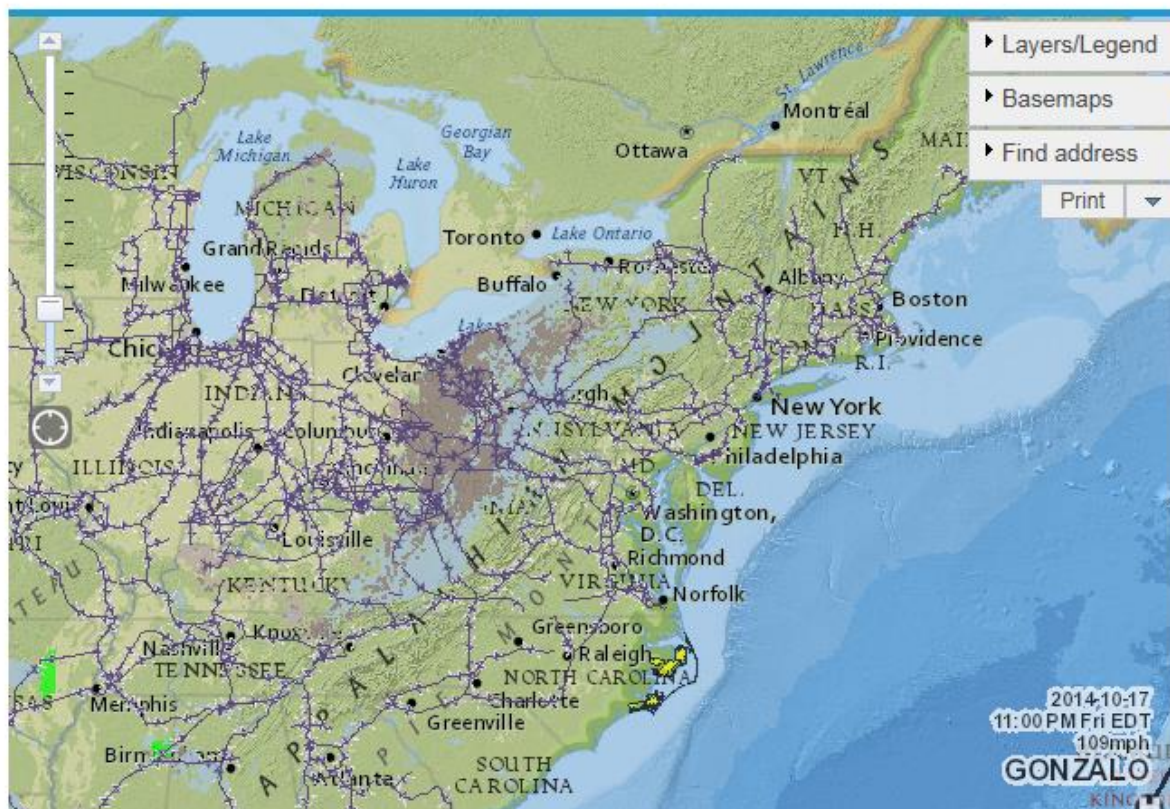




# US Energy Information Administration



## Energy Infrastructure with Real-time Storm Information



### Winter Weather

[DOE Energy Assurance Daily Reports](#)

[DOE Emergency Situation Reports](#)

[National Weather Service](#)

### Hurricane

[Gulf of Mexico Fact Sheet](#)

[Bureau of Ocean Energy Management, Regulation and Enforcement \(BOEMRE\) Hurricane Information](#)

[DOE Emergency Situation Reports](#)

[EIA Hurricane Outlook \(pdf\)](#)

[NOAA National Hurricane Center](#)

### Historical Reports

<http://www.eia.gov/special/disruptions/>



# WaterSense® Water Efficiency Guidance for Federal Agencies

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Federal agencies should:

- Purchase WaterSense Labeled Products
- Specify the Purchase of WaterSense Labeled Products
- Use Contractors Certified by a WaterSense Labeled Program
- Incorporate Water Efficiency Best Management Practices Into Facility Operations
- Purchase FEMP-Designated Energy-Efficient Products



[http://www.epa.gov/watersense/commercial/federal\\_agencies.html](http://www.epa.gov/watersense/commercial/federal_agencies.html)

# FEMP's Water Efficiency BMPs



**BMP #1** - Water Management Planning

**BMP #2** - Information and Education  
Programs

**BMP #3** - Distribution System Audits,  
Leak Detection, and Repair

**BMP #4** - Water-Efficient Landscaping

**BMP #5** - Water-Efficient Irrigation

**BMP #6** - Toilets and Urinals

**BMP #7** - Faucets and Showerheads

**BMP #8** - Boiler/Steam Systems

**BMP #9** - Single-Pass Cooling Equipment

**BMP #10** - Cooling Tower Management

**BMP #11** - Commercial Kitchen  
Equipment

**BMP #12** - Laboratory/Medical Equipment

**BMP #13** - Other Water Intensive  
Processes

**BMP #14** - Alternate Water Sources

[http://www.epa.gov/watersense/commercial/federal\\_agencies.html](http://www.epa.gov/watersense/commercial/federal_agencies.html)

<http://energy.gov/eere/femp/federal-water-efficiency-best-management-practices>



# FEMP's Water Use Reduction On-Demand Training

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- **Best Practices for Comprehensive Water Management for Federal Facilities - Advanced level (301)**

This eTraining core course provides Federal facility and energy managers with knowledge and skills to assist in meeting water-related legislative and executive order requirements.

- **Managing Water Assessments in Federal Facilities - Intermediate level (201)**

This eTraining core course focuses on water-assessment process

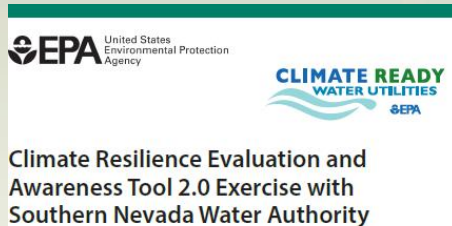
- **Water Efficiency Planning and Implementation – Introductory Level (101)**

First Thursday Seminar provides a strategic planning overview of developing and implementing a water-efficiency program





# EPA's Climate Ready Water Utilities



EPA's Climate Ready Water Utilities (CRWU) Website  
<http://water.epa.gov/infrastructure/watersecurity/climate/index.cfm>



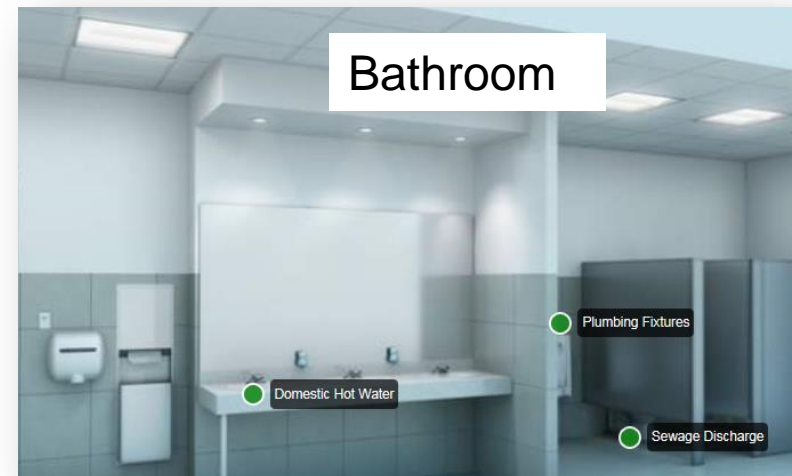
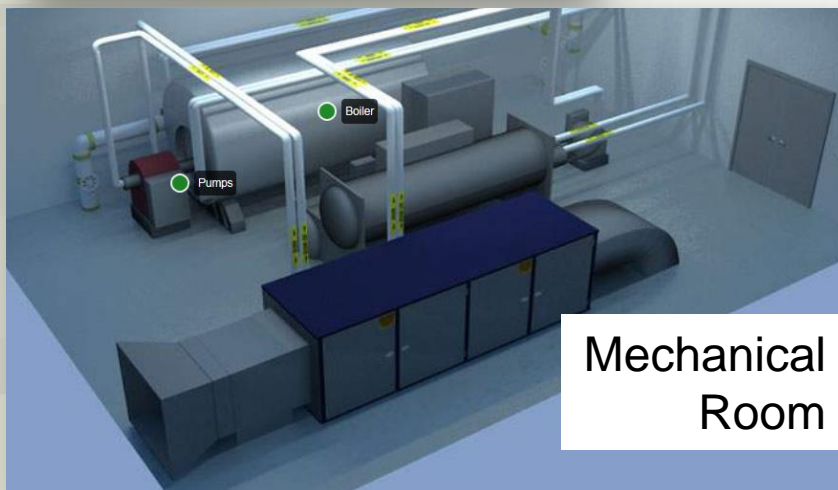
- Climate Resilience Evaluation and Awareness Tool
- Preparing for Extreme Weather Events: Workshop Planner for the Water Sector
- Climate Ready Water Utilities Toolbox
- Adaptation Strategies Guide
- The **Adaptive Response Framework for Drinking Water and Wastewater Utilities** describes approaches for water utilities seeking to become more “climate ready.”

<http://water.epa.gov/infrastructure/watersecurity/climate/upload/epa817f12009.pdf>



# Sustainable Facilities Tool (SFT) Water

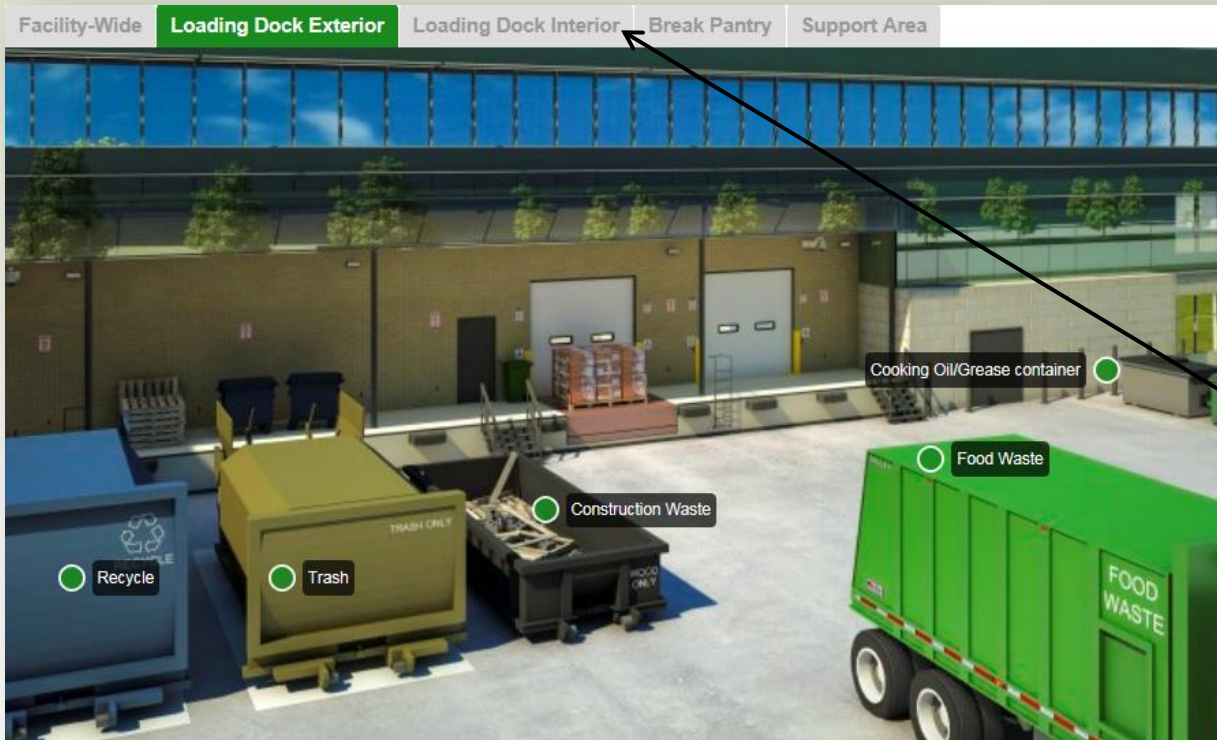
Users can click on the labels for detailed guidance



<https://sftool.gov/explore/green-building/section/18/water/system-overview#facility-wide>



# Sustainable Facilities Tool (SFT) Solid Waste



Loading Dock Interior



# DoD's Sustainable Products Center



## DENIX

DoD Environment, Safety and Occupational  
Health Network and Information Exchange

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<https://www.denix.osd.mil/spc/>

[Programs](#) | [Performance](#) | [Stakeholders](#) | [References](#) | [Conferences & Training](#) | [DOD Workgroups](#)

Search



## SUSTAINABLE PRODUCTS CENTER



DoD Sustainable Products  
Center (SPC) Home

Sustainable Procurement



Sustainable Procurement Home

Why Purchase Sustainable  
Products

How to Purchase Sustainable  
Products

Sustainable Program Areas



Outreach & Meetings



Demonstrations



News & Success Stories



FAQs

Resources

Stakeholders

Policies, Programs and  
Guidance



Contact DoD Sustainable  
Products Center



### Welcome to the New Department of Defense Sustainable Products Center

DoD's Sustainable Products Center (SPC) is an independent virtual center or focal point that integrates information on sustainable products and serves as DoD's informational repository for these products and their respective performances to include demonstrations of alternative green products and services conducted at DoD installations.

- The Defense Environmental Network and Information eXchange (DENIX) will host the SPC website.
- The SPC Team will conduct outreach activities to include site visits to various military installations in order to collect information on areas of need for sustainable alternatives.
- The Team will identify and evaluate Sustainable Alternatives against existing Military Specifications or Government requirements, and then select the viable candidates for Pilot demonstrations at DoD installations in which the proposed sustainable alternatives will be evaluated side-by-side with the currently used non-sustainable ones.

### Request for Information

If you have any questions or comments regarding sustainable products or the SPC, please contact us.

Please provide us with your name, title, installation, and the urgency of your question and the SPC will respond to you as quickly as possible.



### Latest News

[A Profile In Biobased Success:  
Going Green is Not Going Soft:  
Soy Biobased Penetrating  
Lubricants & Spill Sorbents  
Succeed in DLA Demonstrations](#)

### Featured Demonstration



# Food Waste Resources



## The Food Waste Management Calculator

<http://www.epa.gov/waste/conserve/foodwaste/docs/foodcost.xls>

### Food Waste Management Inputs

#### Source Reduction

What type of facility are you?	<b>Hospital</b> ▼
How many pounds of non-perishable food waste do you generate per week?	Grocery Store Restaurant University
What percentage of non-perishable food waste are you willing to source reduce?	<b>Hospital</b>
How many pounds of pre-consumer prepared/whole food waste do you generate per week?	K-12 School Prison Other Cafeteria Other
What percentage of pre-consumer prepared/whole food waste are you willing to source reduce?	
How many pounds of pre-consumer trim waste do you generate per week?	0
What percentage of pre-consumer trim waste are you willing to source reduce?	0%
How many pounds of post-consumer plate waste do you generate per week?	0
What percentage of post-consumer plate waste are you willing to source reduce?	0%
How much yellow grease do you generate per week?	0
What is your average purchasing cost per pound for non-perishables?	\$0.00

► Cover Sheet **Inputs** Cost Calculator Cost Data Cost Graphs Benefits Composting Env. Benefits Summary Resource

This Tool can be used to determine the cost of food waste and benefits of diversion at Army DFACs, Food Courts, Schools, Commissaries, etc.



# Food Waste Resources



EPA's Food Waste Tracking Tool also Provides Handy Conversion Tabs for Converting Packaging and Food Waste into Pounds.

Kitchen Packaging Waste	Waste Name	Unit	Weight per Unit (lbs)	Number of Units	Weight (lbs)
Paper/Cardboard	egg flats	one dozen	0.12	1	0.12
	paper sacks	25# size	0.5	1	0.5
	paper sacks	50# dry goods	1	1	1
	beverage case	6 pack	0.2	1	0.2
	cereal box	average	0.15	1	0.15
	cardboard beverage case	4 six-packs, full case	0.99	1	0.99
	cardboard box, large	48" x 48" x 60"	4	1	4
	cardboard boxes, stacked	cubic yard	50	1	50
Aluminum/Steel					0
					0
	aluminum foil, loose	cubic yard	48.1	1	48.1
	aluminum cans, crushed	case (24 cans)	0.89	1	0.89
	aluminum can	12-oz can	0.03	1	0.03
	steel soup can	15.5-oz can	0.11	1	0.11
Plastic					0
					0
	gallon milk/juice HDPE container	gallon container	0.22	1	0.22
	8 oz juice HDPE container	8 oz container	0.1	1	0.1
	2 liter PET bottle	2 liter bottle	0.13	1	0.13
	gallon mayo container	1 gallon container	0.42	1	0.42
Glass					0
					0
	gallon jug	each	2.45	1	2.45
	beer bottle	each	0.53	1	0.53
	12 oz beverage	case (24 bottles)	22	1	22
	wine bottle	each	1.08	1	1.08
					0
					0

Step 1 - General Info

Step 2 - Data Collection

Conversion Helper

Step 3 - Data Entry

Audit Data Summary

Stored Data

Sources



EPA's Food and Packaging Waste Prevention Tool

[http://www.epa.gov/waste/conserve/foodwaste/docs/foodwaste\\_audit\\_tool.xlsm](http://www.epa.gov/waste/conserve/foodwaste/docs/foodwaste_audit_tool.xlsm)

# DLA Course Offering: Buying Green: A Multifunctional Approach to P2

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DLA Training Catalog, Workshop Number DCPSO00R750

This course is DOD/Interservice Environmental Education Review Board (ISEERB) approved and includes a forum to share ideas and success stories, Highlights include:

- Procurement Guidelines for Products Containing Recovered Materials (40 CFR 247)
- Bridging the communication gap between acquisition and environmental staffs
- Federal Acquisition Regulation (FAR) requirements
- Pollution Prevention (P2) Hierarchy
- P2 Executive Orders/Regulations
- Green Procurement Program
- Environmentally Preferred Products
- Life-cycle Costing Acquisition Planning



DLA Training Catalog—FY 2015

<http://www.hr.dla.mil/downloads/trn/courses/environmental.pdf>





## CLC 046 Green Procurement

[http://icatalog.dau.mil/onlinecatalog/print.aspx?crs\\_id=497](http://icatalog.dau.mil/onlinecatalog/print.aspx?crs_id=497)



Green procurement is the purchase of products and services with favorable energy or environmental attributes in accordance with federally mandated "green" procurement preference programs.

There are no prerequisites for this course and participants have 60 days to complete the training module.



# Net Zero Reference Documents



## Key Web Documents

OASA-IE&E Website: <http://www.asaie.army.mil/Public/ES/netzero/>

FY2012 Net Zero Progress Report:

[http://www.army.mil/article/103842/Army\\_releases\\_2012\\_Net\\_Zero\\_Progress\\_Report/](http://www.army.mil/article/103842/Army_releases_2012_Net_Zero_Progress_Report/)

Net Zero Water Summary:

<http://www.asaie.army.mil/Public/ES/netzero/docs/NZW%20Programmatic%20Summary-FINAL-10-30-13.pdf>

## Additional Print Documents

Army Net Zero 101 brief

[Army Directive \(2014\)](#)

[NREL Net Zero Energy Roadmap and Program Summary Report \(2013\)](#)

CERL EEAP Assessment at West Point

CTC Net Zero Waste Roadmap

CTC Fort Bliss Energy and Water Security Assessment

CTC Fort Bliss Integrated Roadmap

CTC Net Zero Implementation Guide (To be published in Dec 14).



# Questions?

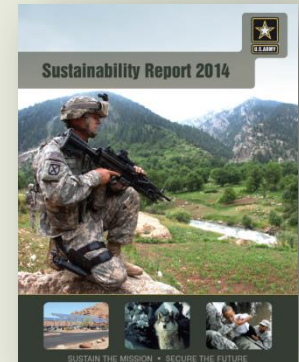


## Army Sustainability Report 2014

<http://usarmy.vo.llnwd.net/e2/c/downloads/367149.pdf>

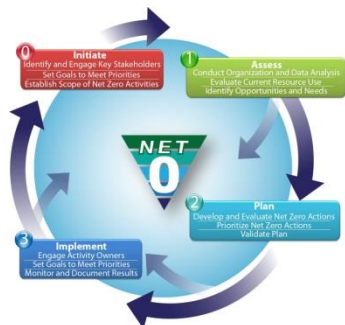
## Office of the Assistant Secretary of the Army for Installations, Energy and Environment

<http://www.army.mil/asaiee>



## Office of the Deputy Assistant Secretary of the Army, Energy and Sustainability

<http://www.asaie.army.mil/Public/ES/>



## Army Net Zero

<http://www.asaie.army.mil/Public/ES/netzero/index.html>



## Module #6 Net Zero Training – Resources – Speaker Notes

**Slide 1:** Hello - I am Kristine Kingery. I work in the Army Secretariat in the Office of the Assistant Secretary of the Army for Installations, Energy and Environment. I am the Director of Army Sustainability Policy and the Army lead for the Net Zero Installation Initiative. Thank you for tuning in to Session 6 – the final session of the Net Zero online training: Net Zero Resources

**Slide 2:** This is Module #6 - Net Zero Resources. We begin with a list of topics to be covered.

First on the list of topics is target audience and learning objectives. Basically – who this training was developed for and why. As previously stated, everyone is welcome to learn more about the Army's Net Zero Initiative, however this training is specifically geared for an installations' Energy, Water, or Waste Program Manager (or equivalent), a Master Planner or the installation's Sustainability Officer.

I'll re-review significant points covered in Modules 1 through 5.

Then we'll briefly review resources available specific to each area of Net Zero: Zero Energy, Net Zero Water and Net Zero Waste.

I will then review additional resources and databases available for Army installation personnel to access related to green procurement and incorporating best management practices, the Sustainable Products Center, and the Environmental Protection Agency of which all serve as valuable reference points, and other training available.

The next slide lists the previous Net Zero Online Training Modules.

**Slide 3:** To Review

**Module 1 - Provided** an overview of the Army's Net Zero Initiative

**Module 2 - Focused** on Net Zero as a management approach that the Army developed which includes a step-by-step process - 4 steps: Initiate, Assess, Plan and Implement.

**Module 3** – Delved into the holistic approach towards Net Zero Energy following the hierarchy framework of reduction, efficiency, recovery, cogeneration, and renewable energy.

**Module 4 - Examined** the approach towards Net Zero Water following the hierarchy framework of reduction, efficiency, recycle, reuse, and recharge.

**Module 5** – Explored the approach towards Net Zero Waste following the hierarchy framework of reduction, repurpose, recycling and composting, energy recovery and disposal.

Now let's revisit the History of Sustainability in the Army

**Slide 4:** Forces Command or FORSCOM Installations saw a tremendous growth in sustainable practices during the 1990's – P2 programs were the driving force behind these initiatives that resulted in reduced pesticide use, a reduction in the quantity and toxicity of hazardous waste generated, improved waste diversion rates and decreased water use.

At the start of the new decade, HQ Forces Command initiated the development of the Installation Sustainability Program. At the time there was a growing concern amongst Army leadership about environmental issues and perceived constraints having a negative impact on training missions. The red flag for some was an incident in which community concerns halted training at a National Guard installation. Instead of buckling to the pressure from either side – Army leadership developed an integrated compromise. This compromise - a document which would become the framework for how we view sustainability in the Army today was developed during a Senior Environmental Leadership Conference held in Washington, D.C., entitled **An Operational Directive and Campaign Plan**. It was signed by the Vice Chief of Staff of the Army on November 17, 2000, and mandated “an integrated strategy, with a defined end-state, that **ties resources to objectives** and engages stakeholders at all levels—to sustain the mission.”

By early 2004 – Fort Bragg, Fort Carson and Fort Lewis (now JBLM) had already developed or were in the process of developing their installation level plans and setting their long term sustainability goals. But Sustainability in the Army really became official with publication of the 'Army Strategy for the Environment: Sustain the Mission – Secure the Future' in late FY04.

Since then the goals and strategies have changed – a little – but the underlying theme still and will probably always be to appropriately manage the land and resources the American people have entrusted with the Army in a way that enables the Army to accomplish The Mission now and for future generations.

Because this is just a review we will skip forward and briefly review the main drivers of Net Zero, the Army's Net Zero Pilot Installation Initiative and the evolution of the Net Zero Hierarchy.



**Slide 5:** This slide graphically summarizes the Army's journey towards Net Zero. You can see to the far left of the graphic a list of all the driving forces that moved the Army through the Net Zero Pilot Installation Initiative and the development of the hierarchies.

Through a collaborative process, our pilot installations have made great strides along the Net Zero journey. Their success stories could become the next Army standard as we learn more about increased mission capabilities and cost avoidance achieved from Net Zero.

If you have taken the Net Zero training provided in the previous modules you know there is a specific hierarchy of approaches the Army has developed for Net Zero Energy, Net Zero Water, and Net Zero Waste. In other words – the order in which Net Zero approaches should be implemented. This is a key take-a-way.

Our collective challenge is to adopt and embed these takeaways into standard activities across all installations, and to continue to partner with communities, other agencies, and industry to achieve the most sustainable and cost effective solutions for all parties involved.

Let's review the hierarchies just one more time!

**Slide 6:** The Net Zero Energy hierarchy requires installations to address energy usage and efficiency first and then evaluate recovery and cogeneration options. To plan for energy security, an alternate energy supply to the utility power grid is crucial. On-site energy production enables each installation to plan for continuity of operations if the grid is unavailable. Commercial Power grids owned and controlled by \_ other than Army are increasingly vulnerable and expose Army operations to risk. The Army's risk mitigation strategy is for on-site renewable energy production, both electrical and thermal energy, but it must be fiscally responsible.

We must identify and prioritize threats to drinking water and wastewater infrastructure, evaluate vulnerabilities, plan for countermeasures to reduce the risk of attacks. The Net Zero Water strategy is intended to improve our water security. Again, as with energy, it is a systems approach using the inverted triangle that requires installations to address the freshwater demand through water efficiency and conservation.

Waste avoidance is the most effective reduction method and includes:

Changing our procurement practices to eliminate packaging waste where feasible

Implementing take-back policies in contracts (e.g., modular furniture, appliances, packaging) and expanding our efforts to purchase recycled content, recyclable content, and bio-based products.

An estimated 25-50% of an installation's municipal solid waste is compostable – we need to expand composting operations

We're looking at WTE as a future effort, but only after installations have worked through all the upper levels of the NZ Hierarchy.

OK – now let's take a look at pilot activities.

**Slide 7:** This slide identifies specific activities and actions taken to implement Net Zero at our pilot installations, including establishing a baseline, assessing potential, and integrating results into existing programs. All activities and actions are based on collaboration.

Establishing a baseline involves completing an energy audit, conducting a water balance assessment or a material flow analysis and waste characterization study.

Assessing potential for future activities involves conducting a renewable energy audit, identifying water re-use opportunities, or identifying additional material re-use and waste diversion opportunities.

Net Zero efforts tie these all together. They include project lists and actions to meet a pilot installation's Net Zero goals by fiscal year 2020. Results are then integrated into energy and water master plans, as well as solid waste management plans, which document activities the Army is already doing.

The next slide focuses on Step 2 of the four-step process of Net Zero Implementation

**Slide 8:** Net Zero Implementation: Extensive details were provided in Module 2 about the Net Zero management approach and the four overarching actions: Initiate, Assess, Plan and Implement. These major steps which were specifically developed for Army installations as a result of working with the Net Zero Pilots, serve as the framework by which Army installations should follow in their journey towards Net Zero.

For this module, as the slide suggests, we will focus primarily on Step 2 - Plan:

The list of opportunities that is generated in Step 1 – “Assess” is further evaluated and validated in Step 2 – “Plan”. The Net Zero planning process guides the implementation of actions taken towards Net Zero. Plans, projects and processes that emerge from this step are integrated with other plans and processes at the installation; a separate plan is not produced.

Throughout this module the phrase ‘Net Zero Actions’ or “NZA” refers to potential Best Management Practices or BMPs, opportunities or projects installations evaluate and if proven feasible – are carried through to implementation.

Now we'll go over a tool developed for Step 2 – an evaluation matrix for developing and prioritizing Net Zero Actions.

**Slide 9:** The NDCEE developed a 'scoring sheet' as shown on this slide. This decision evaluation matrix is available to assist installations when planning Net Zero actions. It is built in Microsoft® Excel for ease of use. The installation first leverages previously completed assessments and makes an integrated list of Net Zero Actions (or NZA's as previously discussed). NZA's can be any activity, project, plan or policy taken to move towards an installation's Net Zero goals. The following evaluation criteria were developed and available as a starting point: Impact on Net Zero Water; Impact on Mission Security; First Cost; Pay Back; Savings to Investment Ratio; Years to Realized Net Zero Impact; Critical Predecessor; and Feasibility of Implementation Success. Scores can be assigned using standardized ranges and a scale of 1-5 (larger number is better). Drop-down menus within the spreadsheet enable easy, standardized data entry. Sorting and filtering functions within the spreadsheet enable NZA's to be evaluated along any of the individual criteria, by action type, by the impact criteria only or by the financial criteria only.

The next slide shows the results of a study conducted by the Pacific Northwest lab of common water conservation measures and typical life-cycle cost effectiveness.

**Slide 10:** The Life Cycle Cost analysis identifies the cost effectiveness of each water conservation measure, both individually and as part of a larger bundled project. Water conservation measures are deemed Lifecycle Cost-effective when they have a savings-to-investment ratio (SIR) of greater than 1. This ratio determines the "break-even" point of the project's cost. Therefore, a project is Lifecycle Cost-effective when the total savings stream is greater than the initial water conservation measure cost. The Lifecycle Cost results were used to develop an implementation strategy for each site, including identification of possible funding sources and project phasing to help the installation meet its Net Zero goals.

Other activities that we covered in the previous Net Zero Training modules include Renewable Energy assessments as noted in the next slide.

**Slide 11:** Renewable Energy assessments are a critical part of building a pathway to reach net zero.

You start with tools-based assessment to help identify RE opportunities and screen out unrealistic, unneeded projects – quickly so as not to expend too much time and resources on chasing down an opportunity that just won't work.

Investigate, research, and interview other installation staff members to collect information on past assessments or issues. This is done to help understand local

opportunities or obstacles which aren't readily identified through a remote, tools-based assessment.

Identify RENEWABLE ENERGY technologies and project sites at the installation.

Initiate NEPA action if required – do this as soon as possible.

Network with other stakeholders on the installation to identify potential issues. Stakeholders from master planning, environmental, Range Control, and the Plans, Analysis and Integration Office (PAIO) are top priorities.

Next is the stoplight chart developed by the Office of Energy Initiatives (formerly the Energy Initiatives Task Force) with 8 Assessment Criteria to use when developing renewable energy projects.

**Slide 12:** The OEI developed a framework of 8 Assessment Criteria as a tool to consistently evaluate and manage risks that may threaten project completion. The 8 Assessment Criteria are used to assess risks and support objective decisions that direct Army resources to projects that not only create value, but are cleared of excessive risks. If risks are too high, project efforts should be suspended. Each criterion can be rated on a three-point scale (red, yellow, or green) with red indicating a high level of risk, yellow indicating moderate risk, and green indicating minimized risk. These Criteria can be adapted for evaluation of renewable or traditional power generation projects and provide a proven, standardized framework for evaluating project risks of small, medium and large-scale projects.

Installations pursuing renewable energy projects large-scale or distributed scale should access the OEI's website for more information on developing their projects.

Additionally, the FEMP Guide provides a similar framework of categories and questions for project development. The FEMP Guide can be found at:

<http://www1.eere.energy.gov/femp/pdfs/large-scalereguide.pdf>

The next couple slides will show a sample snapshot of all the various online models and tools available through the National Renewable Energy Laboratory's website.

**Slide 13:** Use models and tools developed or supported by NREL to assess, analyze, and optimize renewable energy and energy efficiency technologies for your project. Many of these tools can be applied on a global, regional, local, or project basis. NREL models and tools include several designed for the consumer or energy professional.

See the next slide for models and tools for Energy Systems Analyses and Economical and Financial Analyses

**Slide 14:** [http://www.nrel.gov/analysis/models\\_tools.html](http://www.nrel.gov/analysis/models_tools.html)

## Models and Tools

Use models and tools developed or supported by NREL to assess, analyze, and optimize renewable energy and energy efficiency technologies for your project. Many of these tools can be applied on a global, regional, local, or project basis. NREL models and tools include several designed for the consumer or energy professional.

Next we'll go over a very unique and informative tool – FEMP's Technology Deployment Matrix.

**Slide 15:** The intent of this Technology Deployment Matrix is to identify and rank new and underused technologies which hold the most promise to impact the federal market in order to prioritize resources in the next several years. Therefore these technologies have been selected on the basis that they can be deployable immediately and have high potential to be incorporated into agency energy-use reduction programs. Technologies were selected through a comprehensive survey of emerging technology evaluation and deployment programs by federal agencies, state energy programs, and public utilities

This is a screenshot of the General Info tab "Technologies for Deployment" from the

The Other Tabs are described below:

- The Summary tab is a brief listing of the top ranked technologies with break outs for the Top 20 (Table 1), Second Tier Technologies from the remaining set of 30 (Table 2), and the complete listing of technologies ranked from 21 - 50 (Table 3).
- Overall Ranking tab - This list includes all 50 Technologies in ranked order with descriptions and a more detailed break out of scoring.
- Tech by Category - Technologies are listed by their major energy end-use category
- Resources - Listings of manufacturers; and links to technology briefs, case studies, reports and available calculators and tools.
- Ranking Criteria - More detail on the methodology and how technologies were ranked and scored.

**Slide 16:** The Federal Energy Management Program or FEMP provides training to Federal agency managers to foster and maintain a high-performance workforce to construct, operate, and maintain facilities in an energy-efficient, sustainable, and cost-effective manner. Topics include proven, cutting-edge technologies and business practices to help agencies meet their energy, water, and sustainability goals dictated by Federal laws and requirements.

FEMP's First Thursday Seminars are an excellent resource for an Army installation Energy or Water Program Manager. The series are offered in live workshops and webinars and on-demand at three levels – introductory, intermediate and advanced.

The Federal Energy Management Program (FEMP).

The First Thursday Seminar pictured in the slide covers operations and maintenance (O&M) best practices for photovoltaic (PV) systems of 100 kW or less, including planning for a PV O&M “scope of work” and maintenance procedures to keep the system operating at optimal capacity.

FEMP is accredited by the International Association for Continuing Education and Training and awards continuing education units upon the successful completion of select courses.

Next slide we will discuss the EPA's Energy Star Portfolio Manager's Sustainable Buildings Checklist.

**Slide 17:** The Sustainable Buildings Checklist was first developed for United States federal building managers for compliance with the Federal Guiding Principles for High Performance Sustainable Buildings as part of EPA's *ENERGY STAR Portfolio Manager* Tool. It helps measure and track energy use, water use, and greenhouse gas emissions of buildings, identify under-performing buildings and verify efficiency improvements. The Sustainable Buildings Checklist is a valuable tool for evaluating the sustainability of any type of existing building.

In the next slide I will briefly discuss an online mapping tool that, among other advanced applications, allows the user to track storms that might affect critical infrastructure – like power plants.

**Slide 18:** The US Energy Information Administration's website contains interactive tools and provides filters to run reports on everything from the short-term energy outlook to US Renewable Energy Production and Consumption by Source.

This is a screenshot of the Energy Disruptions section. The EIA tracks and reports on selected significant storms that impact or could potentially impact energy infrastructure. See past historical events reported on right or real time storm tracking with the energy infrastructure map.

We now begin with a discussion on tools and resources for Net Zero Water. I will start with a discussion on WaterSense.

**Slide 19:** The Chairman of the Council on Environmental Quality has issued supplemental guidance to the instructions for implementing Executive Order 13423 and

is developing guidance for Executive Order 13514. Where applicable, federal agencies should purchase water-efficient products and services, including WaterSense labeled products, and hire contractors who are certified by a WaterSense labeled program. The Federal Guidance page of the EPA's WaterSense website is designed to assist federal agencies in fulfilling these requirements. To comply, federal agencies should:

**Purchase WaterSense Labeled Products.** On average, WaterSense labeled products are 20 percent more water-efficient than conventional models on the market, and provide equal or superior performance. All WaterSense labeled products are certified to meet EPA's efficiency and performance criteria by an independent, third-party laboratory. WaterSense currently labels a variety of both indoor and outdoor products that can be found in retail locations nationwide.

**Specify the Purchase of WaterSense Labeled Products.** Incorporate the following procurement language into purchasing agreements:

*The vendor must, where applicable, provide WaterSense labeled products. The vendor is encouraged to check for updated lists of WaterSense labeled products.*

**Use Contractors Certified by a WaterSense Labeled Program.** WaterSense labeled programs are available for irrigation system installation and maintenance professionals, irrigation system designers, and irrigation system auditors. Irrigation professionals certified by a WaterSense labeled program have demonstrated their expertise in water-efficient irrigation technologies and techniques and can help you design and install a new irrigation system or audit an existing one to minimize the amount of water used, greening the facility in more ways than one.

**Incorporate Water Efficiency Best Management Practices Into Facility Operations.** The best management practices included in WaterSense at Work can help federal facilities reduce water use in their operations. To further help identify water-efficient products and practices that will enable water consumption reduction and comply with Executive Order 13423, FEMP and EPA's WaterSense program have coordinated to develop 14 best management practices (see next slide) that can be implemented and tailored to meet installation, Army, DoD and Federal water efficiency goals.

**Purchase FEMP-Designated Energy-Efficient Products.** FEMP provides purchasing specifications for many energy and water-efficient products not currently covered by WaterSense specifications. For more information, please visit the FEMP Energy-Efficient Products Website.

I will now re-review the 14 BMP's for Water.

**Slide 20:** FEMP and WaterSense BMPs. This slide show the 14 Best Management Practices collected and published by the Federal Energy Management Program (FEMP) and EPA's WaterSense program. These BMPs can help installations reduce water use in their operations. Installations are encouraged to give first priority to #3 – if fiscally prudent – as Net Zero Pilot installations have affected results in water loss prevention and cost savings following leak detection surveys and subsequent mitigation.

The next slide will provide three key training courses offered by FEMP

**Slide 21:** FEMP also provides an advanced course on Best Practices for Comprehensive Water Management for Federal Facilities

Installations are encouraged to learn more about these Best Practices in their efforts in meeting water-related legislative and executive order requirements. Army installation personnel will develop skills in increasing water efficiency and reducing water use through sound operations and maintenance practices and water-efficient technologies. Several methods for meeting needs for non-potable water through alternate water sources, such as rainwater harvesting, reclaimed wastewater, and gray water are discussed. Water metering is covered, as well as life cycle costing and establishing the overall economics for strategic water management.

### **Learning Objectives**

Upon completing this course, you will be able to:

Select indoor, outdoor, process, and irrigation water efficiency solutions and demonstrate knowledge of technologies, O&M best practices, and life cycle cost analysis techniques

Choose the best methods for distribution system leak detection and repair

Select alternate water sources to meet facility needs for non-potable water uses

Apply the ideal water metering options to understand water performance and develop a long-range water management plan.

**Managing Water Assessments in Federal Facilities - Intermediate level (201).** This eTraining core course focuses on managing the water-assessment process in Federal facilities and assists the Federal energy and facility managers comply with executive orders and legislative mandates and meet the requirements of Section 432 of the Energy Independence and Security Act of 2007. This course provides details on a five-step process for conducting (or managing the conduct of) a comprehensive water assessment, including developing a water balance, conducting a walkthrough survey, developing water conservation measures and long-range plans for water efficiency.



This course focuses on key applications in the Federal sector, incorporating best practices and practical advice from experts in Federal water assessments. Water-efficient technologies are discussed, as are models and templates for contracting for water assessment services.

## **Water Efficiency Planning and Implementation – Introductory Level (101)**

This First Thursday Seminar provides a strategic planning overview of developing and implementing a water-efficiency program

### **Learning Objectives include the following:**

- Discuss related Federal laws and regulations
- Learn how to establish baseline measurements
- Determine water end uses
- Discuss walk-through surveys and water bills, and water-saving technologies
- Understand cooling-tower efficiencies, water reuse, and leak detection
- Explore financing options and drought management

### **Slide 22: EPA's Climate Ready Water Utilities (CRWU) Website**

The impacts of events such as Hurricane Sandy pose challenges to water sector utilities. Extreme weather events, sea level rise, shifting precipitation patterns and temperature variability, all intensified by climate change, have significant implications for the sustainability of the water sector. By planning for, assessing and adapting to these challenges, the water sector can fulfill their public health and environmental missions and begin the process of becoming climate ready.

To set the foundation for our climate ready efforts, EPA convened a CRWU Working Group. The National Drinking Water Advisory Council (NDWAC) delivered its CRWU Report to EPA in January 2011. The report includes 11 findings and 12 recommendations, an Adaptive Response Framework to guide climate ready activities and the identification of needed resources and possible incentives to support and encourage utility climate readiness.

The Climate Ready Water Utilities website supports the water sector, which includes drinking water, wastewater, and stormwater utilities, in addressing climate change impacts. Through the development of practical and easy-to-use tools, EPA promotes a clear understanding of climate science and adaptation options by translating complex climate projections into accessible formats. This information helps utility owners and operators better prepare their systems for the impacts of climate change.

### **The Adaptive Response Framework for Drinking Water and Wastewater Utilities**

This Framework supports and guides utilities as they learn about and pursue management techniques and adaptive actions that can be implemented to build climate

readiness. The Framework is described in the Climate Ready Water Utilities report, developed by the National Drinking Water Advisory Council.

Next I will discuss the General Services Administration or GSA's Sustainable Facilities Tool (SFT) for Water.

**Slide 23:** The Sustainable Facilities Tool (SFT) provided by the General Services Administration (GSA) is a whole building design tool for Federal facilities. Users can explore this easy-to-navigate tool to identify and prioritize cost-effective green building strategies that can be implemented to incorporate sustainable concepts into any remodel or small project. It also provides guidance on how to select sustainable materials, incorporate daylighting strategies, educate occupants, save on water, conserve energy and reference relevant regulations.

This slide shows the Water section of SFT where users can click on any of the labels for information on things to consider. For example when Plumbing Fixtures is selected information is provided on alternatives to conventional fixtures such as WaterSense labeled high efficiency toilets, urinals, faucets, and showers. Information on bundles, system relationships and Indoor Environmental Quality or IEQ is also provided:

Bundles: Optimize Energy Efficiency Optimize Water Systems Human Behavior

System Relationships:

- HVAC
- Waste heat from HVAC systems can be used to pre-heat domestic hot water.
- Capturing condensate from HVAC units can be used as a non-potable water source for flushing toilets and urinals.

IEQ

- Automated sensor faucets limit the passing of germs from occupant to occupant.
- Proper maintenance of toilets and urinals, including reducing leaks and odors, is needed to avoid unhealthy indoor environments.
- Poorly calibrated sensors on faucets and toilets can lead to occupant frustration and wasted water.
- Some non-water urinals need specialized treatments to the bowl area and require regular replacement of specific parts. Ensure that the custodial staff is properly trained in the maintenance of this water-saving technology

Now we will take a look at the Sustainable Facilities Tool for Solid Waste and then review Net Zero Waste resources.

**Slide 24:** The Solid Waste section of the SFT provides additional snapshots of interior and exterior loading docks as shown on the slide as well as support areas like copy rooms. Like the Water section, users can click on any label to learn more about each. The example I will provide for this one is Recycling Program from the facility-wide tab. When selected, information is provided on the two predominant recycling collection methods: commingled recycling (easier for recycling companies) and single stream recycling (easier for building occupants).

#### Commingled Recycling

Commingled Recycling is the collection of paper/cardboard and glass/plastic/metal in separate bins, respectively. Some building recycling programs further separate the collection of recyclables so that different types (or “grades”) of paper, glass, plastics, and metals are each collected in their own separate designated bins. This is called source separated recycling and it can yield higher revenues because sorted materials have a higher market value. The benefits and challenges are similar for both commingled and source separated recycling. Sorted materials have a higher market value. In metropolitan areas, recycling companies will pay for or pick up recyclables at no cost or share revenue. Here are a couple pros and cons to consider about commingled recycling:

- Potential higher recovery rate because of less “contamination” of materials.
- Potential for greater energy and greenhouse gas (GHG) emissions benefits, as higher quality material can be used as feedstock for manufacturing. For example, discarded glass can be recycled into new glass products.
- Separate bins and collection for paper/cardboard and glass/plastic/metal may add to capital costs.
- Building occupants need to discard materials in appropriate separate bins. Potentially confusing, building occupants may place materials in the wrong bins if the communication and recycling program design is unclear.

#### Single Stream Recycling

Single Stream Recycling is the collection of recyclables, including paper, cardboard, glass, plastic, and metal, in a single container at the building. The waste service vendor picks up and hauls these recyclables to a Materials Recovery Facility (MRF), where the recyclables are sorted by material type and sold to end recycling markets for use in product manufacturing. Here are some pros and cons to consider:

- Convenient and easy to collect. The user can mix all recyclable items in a single container for disposal.
- The responsibility of separating different types of waste materials is shifted from the building occupants to the MRF.
- Potentially increases the number of materials collected for recycling at the building.
- Reduces the number of collection trucks needed.
- Mixed, single stream materials have a lower market value. The disposal cost may be higher than commingled recycling service.
- Potentially lower recovery of materials for recycling, after materials are shipped out of the building, because of reduced quality of material as a feedstock in the manufacturing process.
- Potentially lower-end, or downcycled, product uses because of reduced quality of material.

Other areas to explore using the SFT include Heating, Venting and Air Conditioning or HVAC, Indoor Environmental Quality, Lighting, and Green Roofs. The green roofs is an especially excellent resource for information on how Green roofs use plants as a technology to help bring the natural cooling, water-treatment and air filtration properties of vegetated landscapes to the urban environment.

Next I will discuss the Sustainable Products Center developed by the DoD and accessible on DENIX.

**Slide 25:** The Sustainable Products Center is a relatively new website hosted by the Defense Environmental Network and Information eXchange (or DENIX) and serves as DoD's informational repository for everything sustainable procurement related. Information on all federal and DoD sustainable procurement programs and policies are consolidated so that those who visit the SPC website can quickly browse through all of this information to get a clear understanding of all sustainable procurement-related regulations and goals.

The SPC is unique in that it is the first venue to report on the performance of sustainable products to include demonstrations of alternative green products and services conducted at DoD installations. The SPC evaluates the performance of sustainable products in operational environments at DoD installations. Prior to conducting these demonstrations, the SPC identifies applicable Government/Military/Commercial technical requirements and verifies that the

demonstration products meet these requirements. This is achieved by working closely with manufacturers and owners of technical requirements. During the sustainable product demonstrations, the project team closely monitors product performance by soliciting user feedback. The project team uses this information to select the top performing products for inclusion in Defense Logistics Agency and other federal procurement systems. The purpose of these demonstrations is to ensure that sustainable products perform well and meet end users' needs before being included in federal procurement systems. End users can visit the SPC to find sustainable products to suit their needs; learn about the performance of sustainable products; submit any questions, reviews, and/or challenges in regard to procuring sustainable products; and initiate a sustainable product demonstration at their installation.

Next we'll discuss two simple to use food waste tools developed by the EPA that are available online.

**Slide 26:** The Food Waste Management Calculator

The Food Waste Management Calculator estimates the cost competitiveness of alternatives to food waste disposal, including source reduction, donation, composting, and recycling of yellow grease. Specifically, the calculator (1) develops an alternative food waste management scenario based on: your waste profile, availability of diversion methods, and preferences; and (2) compares cost estimates for a disposal versus an alternative scenario. The Cost Calculator demonstrates that environmentally and socially responsible food waste management is cost-effective for many facilities and waste streams. The more you know about your current waste management costs, the more accurate the calculator's estimate will be, but default values are provided for many variables. Although this tool was not specifically developed for an Army installation, it is still a useful tool – especially for a Recycling Manager who is trying to get support for a food waste diversion program as cost savings can be shown with this tool along with Greenhouse gas reduction and other benefits.

For the next slide we will discuss another EPA developed food waste tool that focuses on tracking food waste.

**Slide 27:** EPA's Food and Packaging Waste Prevention Tool

The first step in reducing food waste is to measure and track where the waste is being generated, how much, how often and what type of food waste. The Food and Packaging Waste Prevention Tool (an Excel spreadsheet) can be used to track these food wastes and associated packaging to facilitate waste reduction and reduce costs. Food waste is tracked using paper logs noting the daily amount, type of, and reason for wasted food and packaging. Users then enter this information into the Food and

Packaging Waste Prevention Tool spreadsheet and it automatically creates graphs and data summaries to help identify patterns of waste generation.

For the next couple slides we will discuss green procurement training courses offered by the Defense Logistics Agency (DLA) and Defense Acquisition University.

**Slide 28:** There are several resources available to Army installation personnel for sustainable or green procurement training offered through the Defense Acquisition University (DAU), or the Defense Logistics Agency (DLA). See slide for a link to DLA's FY15 Training Catalog or go to <http://www.hr.dla.mil/downloads/trn/courses/environmental.pdf>. See next slide for a DAU course.

Although Net Zero Waste is not mentioned in the course description on this slide, green procurement is just one tool to help installations along on their Net Zero journey.

This workshop - *Buying Green: A Multifunctional Approach to Pollution Prevention* (or P2) provides an overview of Federal pollution prevention initiatives and how they relate to the DOD acquisition process. This workshop is designed for DOD and other Federal employees in the buying community. This includes employees responsible for purchasing or writing specifications to purchase items that can be made from recovered materials, or items that offer some other environmentally friendly attribute. Through this workshop Federal employees learn how, through affirmative procurement, markets for recovered materials and environmentally preferred products and services can be created.

There is a charge for this 2-day training course either by the student or by the classroom (30 students max) and qualifies for 1.6 continuing education units. For more information call 1-800-458-7903 or DSN 850-5989.

Next slide summarizes the DAU green procurement course.

**Slide 29:** DAU's Green Procurement course as noted in the slide, is one of several resources for sustainable or green procurement training offered through the Defense Acquisition University (DAU). The Department of Defense's Green Procurement Program is a comprehensive strategy for implementing environmentally preferred practices while sustaining the overall mission. The overall objective of this lesson is to identify the objectives and background of DoD's Green Procurement Program.

Many more online resources exist and they are rapidly changing. Army Installation personnel should investigate the tools and resources that fit with their objectives and journey towards Net Zero.

**Slide 30:** Additional Net Zero reference documents are listed here. Please copy the links or write down the website addresses for future reference.

**Slide 31:** This concludes the Net Zero online training

Additional information on Net Zero and other Army energy and sustainability programs and policies is available on our office website <http://www.army.mil/ASAIEE>

Thank you for your attention.